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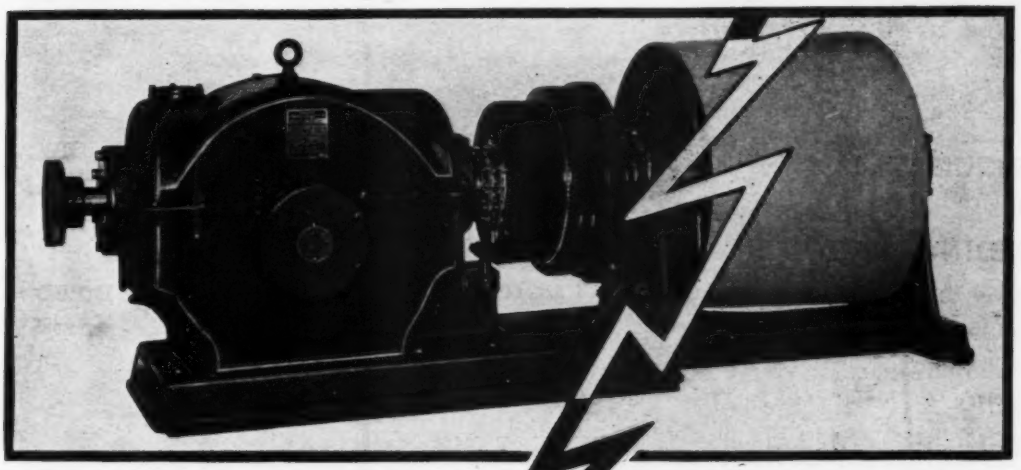

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A MONTHLY EDUCATIONAL JOURNAL
Devoted to the Interests of the Pulp and Paper Industry

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HARRY E. WESTON
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A. SCOTT DOWD
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Terminate the Termite

SUFFICIENT statistics already have been compiled to show that 1935 was a banner tonnage year for the paper industry.

The industry as a whole produced and shipped 10,375,000 tons of paper and paperboard. This figure, as compared with the 1934 shipments of 9,140,000 tons, shows a fine increase amounting to 1,235,000 tons, or 13½ per cent.

This is both a significant and gratifying performance when we take into consideration that the volume of general business activity averaged approximately 70 per cent for the year—or approximately 30 per cent under normal. It is the consensus of opinion that the general business activity figure will go 10 per cent higher this current year, which would indicate a total volume tonnage in the paper industry of 11,500,000 tons for 1936. That certainly is very significant and the increase for 1935 was gratifying, but the increase indicated for 1936 will solve all volume tonnage problems for the producers and in turn be reflected in steadier markets and make possible more profitable operations.

The Kraft Division, covering the operations of some fifty mills, shows the best gain of any division in the industry. Shipments of kraft papers in 1935 were 927,090 tons against 761,572 tons in 1934, a gain of 22 per cent—leading the whole industry average of all papers shipped by 9½ per cent. Dollar shipments of kraft paper increased in 1935 by 24 per cent over 1934 dollar shipments. However, this substantial and unprecedented upturn was only 72.4 per cent of kraft mill capacity, leaving no opportunity for concern on the part of consumers as to the plenitude of supplies, providing the demand is made on the mills (for the tonnage is there).

Analysis of the year's business shows that from now on, emphasis will be placed upon merchandising, and plans for more intelligent marketing and improvement in selling methods will be the order of the day. For there is no reason why the paper industry should not make proper profits on the handsome tonnage assured them.

There is but one method by which profits may be obtained and retained and that is by upholding the price structures and saying "no" emphatically to every attempt of buyers to lodge tonnage, no matter how small, at any price concession under the published minimum market price in each grade of paper.

Last year, in one grade of paper, there was a shrinkage of price of $2.26 per ton between the average price per ton for the year and the average price at which that grade of paper sold for the month of January, 1935. That $2.26 represented no break in the market, but only reflects small concessions made by some over-eager sellers and "little chiseling" in the going prices, but it cost in the aggregate, $650,719.94.

Again, another grade of paper representing a handsome increased volume showed a price shrinkage of $3.68 per ton from the average price at which it was sold for the month of January, 1935, and the year's average price. In the aggregate, it amounted to a loss of $1,682,784 to the mills making that grade. This loss also is attributable to the lack of backbone on the part of mill operators. They "shaded" the

minimum industry price; they gave an "extra commission" and allowed "concessions," which were price-wrecking and inconsistent with good business practice.

These two instances alone—and there are many more in the other divisions—foot up over $2,332,000.

These losses must be stopped. No business management can defend these "profit leaks." If these were mechanical leaks at the mills, they would be caught, checked and plugged without loss of a moment.

The termite which is steadily eating away the profits on volume operations is "price-cutting." It is this most insidious, yet most commonly acknowledged "borer from within" which weakens what otherwise would be a creditable, noble, profitable industrial building. It deprives customers of earnings, salaried employees of advancement, bondholders of interest, and stockholders of dividends.

Price-cutting must be eliminated.

The way to stop it is for each mill management to permit no price-concessions.

The industry needs money bitterly. The way to get it is for every mill to maintain the industry's minimum prices.

We believe that 1936 will be a profit-year to the industry.

No More Experimenting?

THEODORE ROOSEVELT, twenty-fifth president of the United States and one of the most progressive thinkers of his generation, is credited with the statement, "Show me a man who has never made a mistake and I will show you a man who has never done anything."

In other words, the individual who is a worker, who has that inner urge to get things done, who gets joy and satisfaction from accomplishment, is apt to make some mistakes. How could it be otherwise?

It is known that some of the world's greatest discoveries have been the results of mistakes, and progress in pulp and papermaking has not been devoid of them.

There is the story of the papermaker's wife who accidentally dropped some bluing used for laundry purposes into a tub of stock; of the improvement in the color of the stock resulting therefrom; and of the husband's generosity in purchasing for his wife a costly cloak as a token of his sincere appreciation for her contribution to the art of papermaking. Then, too, there is the story of the accidental blow of an undercooked digester charge of sulphate pulp; the effort that was made to refine it rather than discharging it to the sewer as might have been done to get rid of it; and of the sheet of paper that was made from the undercooked stock that really became the genesis of our present-day kraft industry.

These references cover only two of the mistakes made in processing work within the industry that resulted in advancement and progress. There are many more of them. Some may be found by a review of the literature. Others no doubt never found their way into the literature of the industry. Yet they have played their part in the building up of the enormous pulp and paper industry of today.

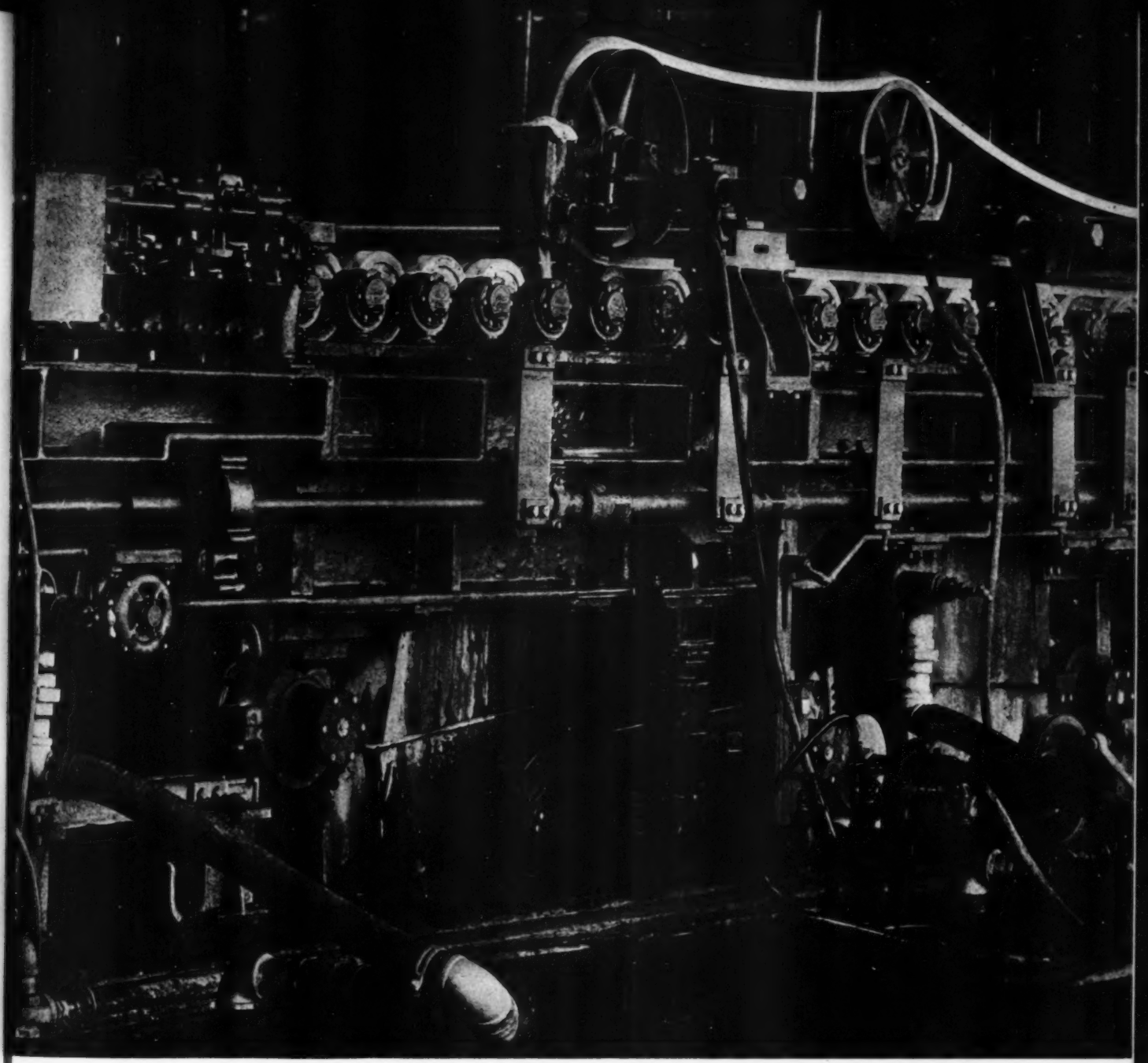
Although such mistakes might not be considered experiments, they can be likened to them as there is much trial and error in most experimental work whether it relates to equipment improvement or to process research.

With full realization of the part that research has played in the past twenty-five years, it hardly seems fitting that activities in this direction should be curtailed in any way—rather they should go forward with unabated energy.

The same thought applies to improvement in design of process equipment. Although mill men often supply equipment manufacturers with facts covering their experiences with certain types of equipment, most of the improvements that are actually incorporated into the designs of the various machines must be put there by the manufacturers of the machines themselves.

To test out such improvements again requires the co-operation of mill men. In this case there are some men that are very reticent about such co-operation. It is their feeling that they have done enough experimenting; that the other fellow should do it; and that if his experience proved satisfactory then they could profit by it.

An attitude of this kind, although sometimes justified, might be very short-sighted at other times. It should not be a case of no more experimenting, but a case of more experimenting with improved design of equipment that is basically sound in principle and in design in order that profits from the use of such equipment might accrue in advance of its more general acceptance by the trade. By giving such equipment manufacturers a break, the pulp and paper mill operative may be giving himself a lead on his competition.



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This 'n That

By WILLIAM SIBLEY

◆WITH THE ADVENT of 1936, the political whirlpool gains momentum and the spray of words leaps higher. That this is leap year will be testified to by politicians as well as Cupid. . . . . And when such staunch Democrats as Al Smith, Davis, Creel, and Talmadge, supplemented by such organizations as the National League for Women Voters, break away and actively oppose the present administration, the New Dealers should waste no time in practicing climbing trees.

◆WHENEVER ANYONE REPEATS, parrot-like, the assertion that this country is suffering from overproduction, I get mad. There is only one other silly assertion that makes me madder and that is the old chromo hanging on some men's mental wall reading "over 90 per cent of America's wealth is held by less than 3 per cent of the population." . . . . But to get back to the overproduction thing: The electrical appliance business is typical of countless other industries—and of the 21,250,000 homes wired for electricity there are still—

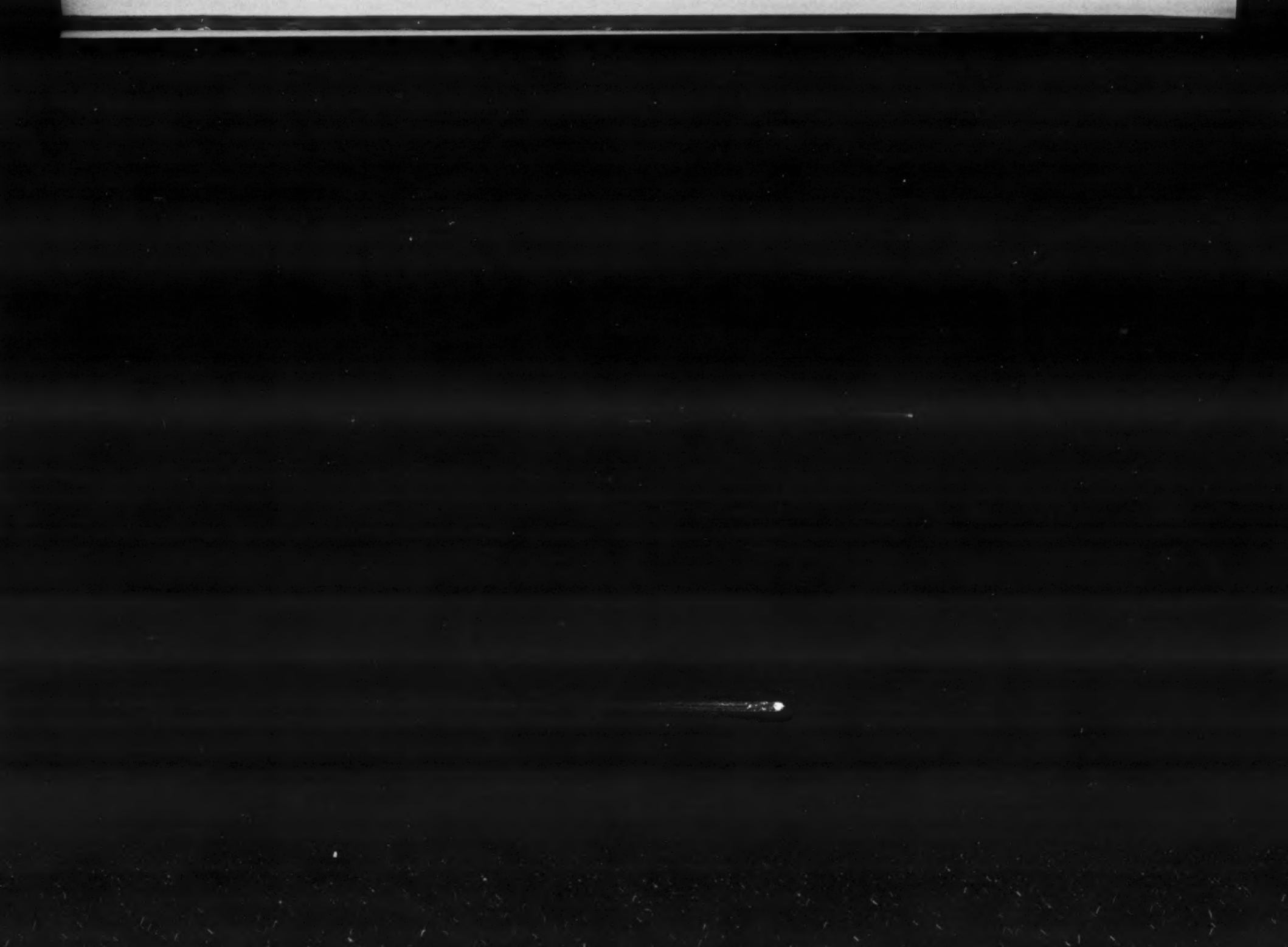
10,960,000 homes that have no vacuum cleaner
12,400,000 homes that have no electric clock
19,900,000 homes that have no electric cooker or casserole
17,300,000 homes that have no electric heater
17,500,000 homes that have no electric heating pad
18,000,000 homes that have no electric hot plate
20,000,000 homes that have no electric ironer
20,250,000 homes that have no oil burner
14,500,000 homes that have no electric percolator
10,000,000 homes that have no electric radio
19,750,000 homes that have no electric range
13,950,000 homes that have no electric refrigerator
10,600,000 homes that have no electric toaster
17,000,000 homes that have no electric waffle iron
10,800,000 homes that have no electric washing machine.

Overproduction, my eye! What this country needs is not less production but less fear of Government and aggressive selling action. If we, as a nation, would roll up our sleeves, forget our inhibitions, discard our conservatism and go out and sell some merchandise (even at the cost of a few per cent appropriation for both advertising and selling expense) we would end this depression in six months. If we, as the paper industry, would get up off of what we are sitting on, cease talking about co-operative advertising, and actually do something about it—we would not have too many paper mills. We wouldn't have enough!

◆THIS YEAR, or 1937 at the latest, holds much promise for the dressmakers—and the paper industry. Crepe paper is being combined with metalized flat papers to produce a brilliant brocade-like fabric. The material is now eminently suited to drapes since it hangs with no tendency to form straight folds. Paper in manufacture but cloth-like in properties the material is being further developed to admit of its use in suitings, dress material, and ordinary apparel. A development of this character would be "cheerio" for the paper industry and "toodle-oo" for the textile people.

◆WELL, THE HEROES UNION won! The bonus, which was granted some years ago for the purpose of eliminating for all time the question of pensions to World War veterans, and which was to be paid in 1945, is going to be paid now, and thereby pave the way for some vote-seeking senator to introduce a pension bill along about—1945. All we need now is some costly sort of compromise to Dr. Townsend's chimerical dream and our potential inflation will presently become a reality. And I (who, as a buck-private, spent 22 months in France without hearing a shot fired or seeing a puff of smoke,—like two million other "heroes") will now be the recipient of needless bonus money which will probably cost me, cash out of pocket, two dollars for one—and cost you, who may not have been in service, another two dollars for nothing.

◆DURING 1929, there were 513 men who reported an income of one million dollars or more. During 1933, that number had been reduced to 46. For 1934, the number was down to 32. The number probably will not be far removed from that figure for 1935. How the "sock the rich" policy is working!



THE PAPER INDUSTRY
A MONTHLY EDUCATIONAL JOURNAL

Progress of Latex

. . . in the Paper Industry

R. L. FINE

BECAUSE of the traditional manufacturing methods employed in paper manufacture, new suggestions are treated cautiously until the suggested material or process has gone through a long and harried apprenticeship. This factor is well recognized where the incorporation of rubber (generally in its liquid latex form) into paper is concerned. Such attempts at incorporation are relatively new, the first real experiments being conducted but a few years back, although patents on the subject go back much farther. Results coming to the attention of the paper industry based on studies and experiments in the past decade, however, are commanding the concentration of paper technologists on the subject.

The early experiments indicated that rubber latex has some specific effect upon the fibers in the beating engine and upon the rate of hydration of the fibers. As Kaye[1] predicated, "it is in this direction that the value of rubber latex as cheapening agent in paper production will be fully seen when large supplies of latex reach the paper-making countries." But other and more definite results have been ascertained, particularly in the last two or three years. In brief, it is safe to state that improved results obtained in the last few years have been due to two factors: (1) improvements in paper-making technology, and (2) improvements in methods of handling, compounding, applying and transporting latex.

In addition to incorporating rubber with paper fibers, of which there are three distinct methods, rubber is also suitable as a sizing material, as a coating upon magazine papers, and as an adhesive.

Up until recently, one of the principal difficulties experienced by paper and rubber engineers in incorporating latex with paper fibers lay in the control of the coagulation on the fibers so that a proper degree of agglomeration could be obtained. Because of this difficulty, it was too often necessary to return the treated fiber to the beater engine for re-treating in order to obtain a product with satisfactory characteristics. As paper technologists know, alum usually is employed as the coagulating agent. It has since been determined that if the alum is added to the beaten pulp before, rather than after, the liquid rubber is introduced, a more suitable product is conceived. As pointed out by Noble, a sensitized latex also will control coagulation and furthermore will result in uniformity, not only in the fiber arrangement, but also in the distribution of the latex throughout the fibrous sheet.

The use of latex in paper fibers offers four principal advantages:

1—An accelerated rate of hydration.
2—Benefits paper made of good strength but lacking in elasticity.
3—Gives needed strength to weak papers or papers made largely of waste paper.
4—Increases folding number of all grades.

Beckering-Vinckers have established through tests that the folding strength of paper increases with the increasing rubber content. This increased strength is noted where the rubber content is above 4 per cent but below 15 per cent. Above a 15 per cent content there seems to be no further increase. These tests also indicated that tearing length is decreased in the presence of rubber; the stretch, where a rubber content of 25 per cent is employed, gradually increases up to 40 per

cent; the writing quality is substantially improved with ink showing little spreading tendency; and that papers with rubber content are highly impermeable to water.

These results as determined by Beckering-Vinckers[2] for paper treated with various percentages of latex in the beater engine, are shown in the accompanying table.

Rubber Content per cent	Weight per Sq. m.	Cellulose per Sq. m.	Folding Number (Schopper)	Tearing Length (Corrected Meters)	Stretch per cent
0.	64	64.0	697	5280	2.6
3.9	65	62.5	606	4830	3.2
8.7	71	64.8	1420	5480	3.3
12.6	75	65.5	2013	4820	3.3
15.5	75	63.4	2500	4770	3.2
27.9	84	60.6	2316	4400	3.6

As stated, there are three approved methods of incorporating rubber in paper fibers all of which give a homogeneous rubber-fiber sheet formation. These are: incorporation of rubber prior to sheet formation generally termed the "beater process;" incorporation during sheet formation, which calls for the use of liquid rubber by spraying, dipping, doctor roll, etc.; and incorporation of rubber after sheet formation, which is actually the saturation of the sheet after it has been formed and applies more particularly to paper converters, although the paper manufacturer must supply a sheet which lends itself readily to such saturation.

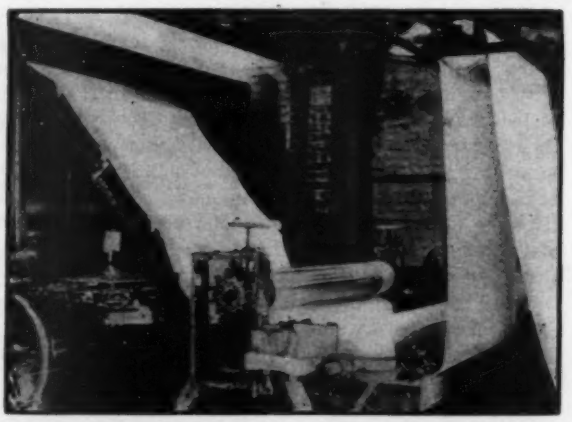
In the "beater process" the fiber, in its usual slurry and only slightly hydrolized, has latex deposited on it. The latex may be compounded or added as vulcanized latex. It may be coagulated on and around the fibers by heat, chemical or mechanical action, according to Townsend.[3] The slurry formed in this manner is discharged from the beater and sheet formed in the regular manner. The beater engine in this process serves merely as a mixing medium. Any other type of equipment, such as the stuff chest, will do equally as well.

Application of latex in paper fibers by the second process, i.e., incorporation during sheet formation, has been partially described. It has been recently determined that prompt coagulation of the latex must take place if the contamination of the equipment is to be duly avoided. Alum in the sheet, the action of heat or acid fumes, or the acidity of the sheet itself,—all of these three factors may cause coagulation.

In order to successfully incorporate rubber, or latex, after sheet formation, it is essential that the sheet, as Townsend points out, be highly absorbent, porous, unsized, non-acid, and, preferably, of long fiber stock. Dozens of saturation methods are in use, each converter seeming to prefer adopting his own experimented-with process. Some dilute the latex compound, add penetrating agents to the compound, initially wet the sheet to be saturated, apply pressure or vacuum effects, and even employ uneven speed rolls as a means of forcing the rubber into some sheet types. In any and all cases, the rubber eventually is coagulated and evaporation of the dispersing phase may serve as the coagulating means.

It has been definitely proved that when rubber is used as the cementing medium for paper fiber, incorporated before or during sheet formation, a marked power consumption reduction is noted since it is not necessary to hydrate the fiber to secure sufficient bond. A high degree of uniformity is also obtained since a stock containing rubber has a slowness on the paper machine. Wildness also is eliminated in a rubber-containing paper stock. Naturally, a slight change in manufacturing operation is called for by these advantageous factors. For instance, if a wet machine were to be utilized for the formation of a rubber-fiber sheet, slipping of the stock on the make-up roll is to be expected. It is possible, however, to adequately remove moisture from the slow stock by means of additional suction boxes among other methods.[4] It is also advisable in this connection to use a more open felt and to clean such felt very completely by the addition of beaters and water sprays to prevent any "plugging" of the equipment. It is claimed that the tendency for plugging of a felt is considerably reduced when vulcanized latex is employed, since such latex is much drier and has little tendency to stick to the felt.

Differing from the "beater process" is a method proving favorable among paper manufacturers, generally termed the top sizing method. It is a much simpler method, the paper being immersed in a sizing mixture of latex, with the mixture containing either glue or casein, run between squeezing rolls, and then dried. Noble claims a mixture of 75 per cent latex and 25 per cent casein produces good results. To further increase water resistance, the treated paper may be subjected to the action of formaldehyde, but such action must be introduced before the treated paper is fully dry.



Here is seen a saturation process in which the paper passes under one or more rolls in the latex bath from which it is removed through squeeze rolls or subjected to the action of one or more scrapers.

Considerable progress has been made in the recent past in the use of latex in coated paper manufacture. Because of keener required properties of coated papers it is essential that the total solids content of latex be as close to standardization as possible. As Birchard[5] pointed out, the "total solids contents vary from shipment to shipment." This was particularly true two or three years ago, but the last several months have seen

a reversal of this condition. Both rubber producers in the Far East and American rubber manufacturers have been diligently working on this problem through the Crude Rubber Committee of the Rubber Division, A.C.S. and the cooperation of numerous rubber producing organizations. Standardization of total solids content of latex is nearer possibility today than six months ago. Paper manufacturers can shortly depend on this form of standardization although it is doubtful whether it will be complete perfection, at least for some time to come. Best practice still recommends the use, as indicated by Birchard, that latex in amounts up to about 5 per cent calculated on the dry filler be used. It has since been determined, however, that the latex is best added to the casein with slow stirring, constantly maintained, after the casein solution has been cooled to approximately 100 deg. F. About one-third of the latex-casein mix is added to the filler and stirred until smooth, the remainder of the mix then being gradually added. The filler mix may be applied on either of the two popular types of coating machines usually found in paper mills. The regular production operation is then carried out, i.e., brushing, festooning, calendering, etc. Use of a double coating machine permits coating on both sides of the paper if preferred. It has also been determined that rubber may be used for coating papers by replacing in whole the casein used in clay coating work. Colored rubber formulations are also securable for the production of manifold colored coatings.

Because friction coagulates most latex formulations, use of rubber is not recommended in the ordinary stack sizing operation. As a sizing medium, however, the property of rubber with relation to moisture-resistance is readily apparent. Properly compounded and vulcanized, the rubber also becomes excellent in its resistance to greases and certain types of oily materials. In this connection rubber is customarily applied by means of a fountain application, tub sizing, or some type of coating machine.

For the impregnation of paper, compounds containing: latex, an anti-oxidant, wetting agent, Dixie clay, zinc oxide, sulphur, an accelerator and Captax, diluted to proper solids depending on the amount of actual rubber which is desired to be left in the paper. Penetration of the paper may be effected by the addition of a wetting agent in the amount of .1 to .2 per cent on the latex.

Latex-treated paper has also been found particularly suitable for dynamite cartridges, this paper burning completely during the explosion, whereas paraffin paper, commonly used in dynamite cartridges, burns incompletely during the explosion forming carbon monoxide gas, an objectionable feature in many cases where these cartridges are employed.

Progress in the use of latex in the paper industry continues to lie in the hands of the research engineers and chemists. Already they have dispelled many of the earlier objections to its uses. They have regulated the size of the rubber coagulum deposited and have prevented the flocculation or existence of large rubber particles throughout a paper sheet, one of the largest of the recent problems. These are but two difficulties since overcome. The advantages to be gained by incorporating rubber or latex in various types of papers continues to be a guiding beacon for further research and beneficial results.

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(1) THE PAPER INDUSTRY, 4, No. 10, 1407 (1923).
(2) Noble, *Latex in Industry*, 1935.
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Base Paper Requirements of Carbon Paper

L. F. SUPPLE, Technical Director
American Manifold Products Corporation

CARBON paper is a generic term for all kinds of manifolding papers, many of which contain no carbon black. This is true of the colored inks used in the manufacture of carbon paper. Like the term "lead pencil" which contains no lead, carbon paper often contains no free carbon. However, the term is commonly used to designate manifolding papers in general. Pigments of practically every color of the spectrum are employed in the manufacture of these papers. Blue and purple papers are used extensively and rank next to black in general use.

According to its use, carbon paper may be roughly classified as typewriter, pencil, pen, billing, register roll, that for special bookkeeping machines and hectograph. Each kind has its special requirements as to ink, weight and type of paper to be used in its manufacture. It is probable that the proper selection of carbon paper for a specific use requires more careful study than does the selection of any other product. Some of the factors influencing the performance of a carbon paper are: the type of machine, hardness of platen, the weight of paper used for copies, the touch of the operator and climatic conditions.

The greatest volume of manifolding papers manufactured is typewriter carbon paper (black). These papers are made from stock ranging in weight from four pounds to twelve or fifteen pounds, depending upon its use. (Weight based on 500 sheets 20 x 30 inches). For manifolding (15 copies), four to five-pound paper is best adapted. For ordinary correspondence work, making three copies, the standard weight is from seven to nine pounds and the heavier paper is coated for special work.

Considering the tremendous volume of business carried on in this industry, there are relatively few manufacturers of a complete line of manifolding papers.

Although manifolding papers probably have been made for many years, it is only during the past twenty-five or thirty years that the clean, hard, sharp writing typewriter carbon papers have been developed. No doubt this is due to several factors: namely, improvement in the raw materials used in the ink, improved facilities for coating the paper, and the great advancements made in the paper industry in producing tissues suitable for carbonizing.

In the appraisal of carbon paper, the following general points are to be considered: (1) appearance, (2) cleanliness, (3) durability, (4) sharpness of impression.

The two most important considerations in the manufacture of all manifolding papers are the paper and the ink used for the coating. Thus, the quality of carbon paper is no better than the paper and the ink used in making it. The paper must be strong, of proper texture, and penetrable to the ink. The ink should be of such a composition as to penetrate the paper and should possess the property of not spending itself too rapidly, thus giving a longer life to the sheet. A carbonized sheet of tissue is not paper with a hardened coating of ink to give manifold copies. It must be thoroughly impregnated with the ink to insure long wear. It is quite obvious that the quality of the tissue used for carbonizing should possess the properties conducive to the production of a superior quality with the requisites described previously.

White paper stock is most generally used for carbonizing, but colored tissues are also widely used. White stock presents a very serious problem. Two rolls of paper of identical weight and quality often will give very different reverse side staining effects with the same ink. Sometimes the staining is deep and intense, while another roll of the same kind of paper produces faint or mottled effects. This is very serious as it is most difficult to convince a customer that a substitution has not been made. Two sheets of carbon paper made from the same batch of ink and coated on the same kind of paper may show a distinct difference in the appearance of the uncoated side. This non-uniformity of staining tissues is a difficulty often encountered in the manufacture of carbon paper.

Another difficulty occasionally experienced is the presence of pin holes in the paper. This is a very serious defect which is found more frequently in the lighter weight tissues.

Non-uniformity in weight in the same roll sometimes occurs, but it is the exception rather than the rule. Tensile strength and bursting strength also are very important, and tissue for carbonizing should be carefully checked on these points.

The best quality of tissue for carbonizing is 100 per cent rag stock. It has been the experience of the author that the best lightweight tissues, four to five pounds, and medium weight tissues, seven to nine pounds, are produced by a well-known English mill. These papers seem to possess to a higher degree than others the necessary qualities for high grade carbon paper such as fineness of texture, tensile strength, penetrability and uniformity. However, domestic tissues in the heavier weights are satisfactory and many high grade carbon papers are made from them.

Sulphite pulp, 100 per cent rag, part rag, and manila paper are used in the cheaper grades of carbon paper. "One time" carbon paper does not require a high grade base paper and it is more economical for the user of such carbon paper to use a cheaper grade. Manila paper is sometimes coated for such uses where durability is not important.

Probably the largest consumer of carbon paper is the Federal Government. The Government does not always specify 100 per cent rag paper, although in the better grades it is required. Federal specifications for the various grades of carbon paper purchased by the Government show the requirements of a very representative class of carbon papers. A few of these requirements are:

"For lightweight typewriter (black) carbon paper, making not less than eight copies at one time, stock shall be 100 per cent rag or manila hemp or jute rope stock or a mixture of these. Weight uncoated on a basis of a sheet 20 x 30 inches, 1000 sheets shall not exceed eleven pounds.

"For standard weight carbon paper (1 to 4 copies), stock shall be free from groundwood pulp. Weight decoated on the basis of 20 x 30 inches 1000 sheets shall not exceed eighteen pounds.

"Serviceability. Shall make not less than fifteen legible first carbon copies."

Paper stock requirements for manifolding papers may be said to vary according to the type of final product and the use to be made of same.

High quality carbon papers of light weight for manifolding paper, require a carbonizing tissue of high tensile strength, high penetration properties and, therefore, good staining qualities. It must be of uniform weight and free from pin holes. Heavier carbonizing tissues must be strong enough to stand high tension and must be penetrable to the inks used to coat them. Many billing carbons do not meet the requirements because they lack tensile strength and toughness to withstand the hard usage they are subjected to on billing machines.

All carbonizing tissues of equal weight and grade should run uniform in staining properties thus enabling the manufacturer of carbon paper to produce an evenly stained product.

◆ ◆ ◆

Fate of the Fourdriniers

It is common knowledge that the papermaking machine was perfected by the brothers Fourdrinier at a cost to themselves of £60,000. It is not so generally known that their patent right was invaded, and they lost a considerable sum of money due to them from the imperial treasury of Russia, although, to enforce his claim, Henry Fourdrinier, at the age of seventy-five, with his daughter, made a special journey to St. Petersburg. The Fourdriniers then petitioned the British Government, the revenue having benefited half a million a year by their inventions, when their claim was inadequately recognized by a parliamentary vote of £7000. It was then resolved to purchase, by the subscription of the papermakers, annuities for the surviving patentee and his two daughters: ere this was done the father died, in his eighty-ninth year; but his two surviving daughters received a small pension from the Crown. *(Spaulding's Quarterly—No. 30.)*

THE PAPER INDUSTRY

◆

Pulp Bleaching

◆ More than one hundred and sixty years have elapsed since Karl Wilhelm Scheele, the great Swedish apothecary, discovered chlorine and invented a process for the bleaching of cotton and linen rags for papermaking. Although it is doubtful if this work ever brought Scheele any financial reward, as much of his mature life was spent in abject poverty, his gift to the world has been of ever-growing importance and has contributed much to the progressive development of the pulp and paper industry.

◆ As early as 1792, a forty-three page booklet on the bleaching of paper was printed in Edinburgh as a protest against a firm of English papermakers that seemingly had a monopoly on the process. Then, in 1799, an English translation by William Nicholson of the work of Pajot des Charmes appeared under the title "The Art of Bleaching Piece-Goods, Cottons, and Threads, of every description . . . composed for the use of manufacturers, bleachers, dyers, callico printers, and paper-makers."

◆ Although some progress was made during the intervening years in improving methods of bleaching, it was left to the introduction and expansion of the chemical woodpulp industry to give energetic impetus to bleaching activities. Even in this instance, much of the advancement in the technique of bleaching and in the equipment employed in the process has been made since the beginning of the present century. In fact, a large portion of this development has come within the past decade at a pace that has been little short of revolutionary.

◆ To recapitulate some of these more recent advancements and to present again some of the more fundamental data on chlorine and the subject of pulp bleaching is the purpose of the following symposium. May it serve in some way as a tribute to the work of Scheele and other early investigators in the field.

Chlorine... its Properties for Pulp Bleaching

HARVEY G. ELLEDGE, Research Chemist
Diamond Alkali Company

◆ THE DISCOVERY of chlorine is accredited to Scheele in 1774, but its identity as an element was established by the work of Davy in 1810. Cruikshank observed the evolution of chlorine upon passing an electric current through a solution of sodium chloride as early as 1800. Some thirty years later, Faraday summarized the salient facts concerning electrolysis in the well-known laws bearing his name. The impetus that would be expected from this work was not felt immediately. According to the patent literature, a period of some fifty years elapsed before there was any marked progress in the development of electrolytic chlorine. The patents recorded for various types of electrolytic cells are numerous from the year 1885, and a few installations appearing about 1890 embodied features that made for their commercial success. In America, the first commercially successful electrolytic chlorine plant was built at a paper mill in 1890.

The property of chlorine that makes of it an important industrial chemical, that is, its remarkable bleaching property, was well known for some fifty years before the identity of chlorine as an element was established. The slow and ineffective method of bleaching textiles—that of spreading the cloth on the grass to receive the action of sunlight and moisture—afforded the incentive that led to the production of chlorinated lime bleaching powder. The paper industry along with the textile industry developed the art of bleaching with bleaching powder. In time, the growing demand for chlorine bleaching agents came to be the most important economic factor in the development of the liquid chlorine industry.

◆ The discovery by Knietsch in 1888 of the fact that in the absence of moisture chlorine at ordinary temperature does not corrode iron or steel, suggested the possibility of the liquefaction of chlorine. This is a notable date and name in the liquid chlorine industry.

Whatever degree of excellence has been or could be attained in the chemical process of making bleaching powder, it could not hold the vantage position over liquid chlorine produced electrolytically. Bleaching powder production is increasing. The following advantages of liquid chlorine motivates the trend just noted: (a) freight saving; (b) labor saving and convenience in handling; (c) stability; (d) absence of calcium salts; and (e) lower cost per unit of chlorine. The tendency toward the displacement of bleaching powder is more pronounced in America and Germany than it is in England.

At first thought, it would seem that the history of the manufacture of electrolytic liquid chlorine in America covers a very short span, yet the time has been sufficient to permit several generations of obsolescence in equipment. The growth of the liquid chlorine industry in America from a few tons to the present output of this commodity is a notable record even under the shadow of the automobile industry covering practically the same time period.

Chlorine gas at a temperature of 32 deg. Fahr. is 2.491 times heavier than air, and as a liquid at –28.7 deg. Fahr. it is 1.558 times heavier than water at the temperature of maximum density. At 32 deg. Fahr., the specific gravity of liquid chlorine is 1.468 and at 68 deg. Fahr. it is 1.41. These are facts pertinent to the manufacture in the design of equipment and shipping containers.

◆ One hundred and eight B.t.u.'s of heat are required to change one pound of liquid to gaseous chlorine at 32 deg. Fahr.; 104 B.t.u.'s at 50 deg. Fahr.; 100 B.t.u.'s at 68 deg. Fahr.; and 97 B.t.u.'s at 86 deg. Fahr., data of interest to the user, explaining among other things why it is impractical to unload an insulated tank car of chlorine from the gaseous phase. By reason of these same facts, heat must be supplied cautiously in cold weather to unload ordinary cylinders from the gaseous phase at a satisfactory rate. The usual expediency is the immersion of the cylinder in flowing water. This heat of vaporization influences the decision between using the gaseous or the liquid phase in chlorinating milk of lime. It is sometimes the cause of the troublesome formation of chlorine hydrate.

One cubic foot of liquid chlorine equals 460 cubic feet of chlorine gas at 60 deg. Fahr. and zero gauge pressure.

One volume of water at 60 deg. Fahr. and zero gauge pressure will absorb approximately 2.37 volumes of chlorine gas to make chlorine water (coefficient of absorption). Chlorine gas or liquid passed into ice water will form a solid called chlorine hydrate ($Cl–8H_2O$), a material sometimes useful to the pulp bleacher but oftentimes the cause of annoyance. Chlorine hydrate at atmospheric pressure is stable at temperatures up to 49 deg. Fahr.

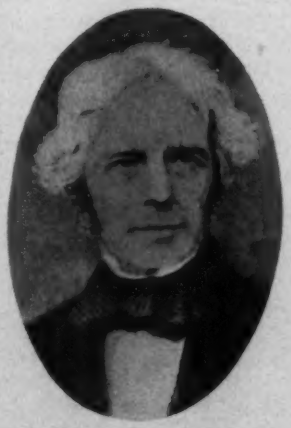
By cooling chlorine gas to –28 deg. Fahr., it is converted to a liquid at atmospheric pressure, or at higher temperatures with correspondingly higher pressures, it forms a property constituting the *conditio sine qua non* of the liquid chlorine industry. At 291 deg. Fahr., a pressure of 1103 pounds per square inch is required. This temperature is called the critical temperature and this pressure the critical pressure, which means that at a temperature above 291 deg. Fahr. the gas can not be liquefied however high the pressure, facts not altogether of academic interest. The vapor pressure of liquid chlorine varies from 20 pound gauge at 10 deg. Fahr. to 70 pounds at 60 deg. Fahr., to 120 pounds at 90 deg. Fahr., to 200 pounds at 120 deg. Fahr. These data are very important in the handling and storage

From *Popular Science Monthly* (October, 1887)

Carl Wilhelm Scheele

From *Popular Science Monthly* (April, 1879)

Sir Humphry Davy



From *The Life and Letters of Faraday* by Dr. Bence Jones (1870)

Michael Faraday

of liquid and are plotted in curves that may be had from manufacturers of liquid chlorine.

Liquid chlorine is of a golden yellow color, a fact of purely academic interest, for few people ever see it as such.

The color of the gas is green from which property the element derives its name, from the Greek word *Chloros*. Chlorine being an active element is not found free in nature, but in abundance in combination with other elements, common salt being the chief commercial source. Its atomic number is 17 and its combining weight is 35.45.

◆ Chlorine gas may be made in a number of ways, such as by the oxidation of hydrochloric acid by air or from salt by means of manganese dioxide in the presence of sulphuric acid. These are classic methods, as may be proved by reference to standard chemical textbooks. Chlorine gas so produced could be dried, compressed and cooled to make liquid chlorine. Historically, bleaching powder was made of chlorine produced in a chemical way. Now the industrial procedure is through the electrolysis of a common salt solution.

The chemistry and physics of the reaction by which sodium chloride and electrical energy are converted into caustic soda, chlorine and hydrogen are comparatively simple. They are explained by the Law of Faraday, which may be expressed as "electricity moves in electrolytes only with the simultaneous movement of their chemically independent components (viz., ions) and is accompanied by the deposition of two different substances upon the electrodes." The energy required may be calculated from thermal data and the expression becomes—

58.45 gms. sodium chloride
water
53 calories of energy

produce
- 40 gms. caustic soda
- 35.45 gms. chlorine
- 1 gm. hydrogen

Since 1 calorie equals .001163 kw. hours and 454 grams equal 1 pound, the expression now may be stated as—

58.45 lbs. sodium chloride
water
28 kw. hours

produce
- 40 lb. caustic soda
- 35.45 lb. chlorine
- 1 lb. hydrogen

which expresses the yields on a basis of 100 per cent current and energy efficiency. The above expression is based on the assumption that only the sodium and chlorine ions carry the current and that the ideal voltage of 2.35 remains constant, assumptions far from engineering experience. The primary reaction is sodium chloride = sodium + chlorine, the chlorine going off at the anode and the sodium being plated out on the cathode, but the sodium immediately reacts with the water, the Na + HOH forming sodium hydroxide (NaOH) or caustic soda and hydrogen (H).

The sodium hydroxide solution leaves the cathode compartment. The hydrogen gas also is delivered from the cathode compartment to be utilized in a number

of ways, such as a source for synthetic ammonia or synthetic hydrochloric acid. The chlorine is delivered from the anode compartment. The gas is dried, refrigerated and compressed to yield pure liquid chlorine ready for market.

The liquid chlorine so produced is "loaded" from holders into 100, 150 and 2000 pound cylinders and into 16 and 30 ton tank cars, containers familiar to consumers in the pulp and paper trades.

◆ Perfectly dry chlorine is not an effective bleach. In the presence of moisture it is a very active and effective bleaching agent. In nearly all applications of chlorine, in bleaching both paper and textiles, and in sanitation, chlorine finds its way into the necessary chemical reaction through the intermediary hypochlorite compound. In pulp and paper, the compound is usually calcium hypochlorite which is made by passing chlorine into milk of lime or calcium hydroxide solution (suspension). In textiles, it is usually sodium hypochlorite made by passing chlorine into caustic soda solution.

However, a review of the more recent patent and technical literature reveals expressions such as "chlorine water bleaching," "hypochlorous acid bleaching," and "hypochlorite bleaching." A study of the possible reactions and objectives sought as indicated by these expressions, suggests the view that all can be looked upon as hypochlorite bleaching under varied conditions of acidity or alkalinity as the case may be.

First, consider the Chlorinating Pulping Process or subsequent modifications of its general principle that have been proposed or actually applied to the bleaching of pulp. When chlorine hydrate, gaseous or liquid chlorine is passed into water, what does really happen? For one thing, the chlorine, or a large portion of it, reacts with the water. This is shown by the high absorption co-efficient, as well as by other evidence. One liter of water will absorb 17 cc. of an inert gas such as nitrogen, while one liter of water will absorb 2370 cc. of chlorine. By the absorption of the chlorine the water becomes distinctly acid in addition to acquiring strong bleaching properties. What happens, partly at least, may be represented by the following equation:

HOH	+	Cl	⇄	HCl	+	HOCl
Water		Chlorine		Hydrochloric Acid		Hypochlorous Acid

So that in chlorine water there is present some dissolved chlorine, some hypochlorous and hydrochloric acid and their respective ions. Chlorine water is distinctly unstable and if left standing will increase in acidity and lose its bleaching power, especially in the presence of light. The hypochlorous acid changes to free oxygen and hydrochloric acid. Any hypochlorite solution that is acid or is made acid will decompose more or less quickly, according to the concentration and the presence of certain catalysts. Hypochlorous acid is not an article of commerce, but a solution containing it may be made and applied in a paper mill by the simple procedure of dissolving chlorine in water. It also may be made in other ways.

Finely ground lime stone suspended in water may be chlorinated to produce hypochlorous acid, some calcium hypochlorite and calcium chloride. Such a solution will be less acid than one of the same available chlorine concentration prepared from water and chlorine. In fact, it may be made to have a pH of about 6.8 or just slightly acid. Hypochlorous acid is a very weak acid. The reaction in chlorinating suspended calcium carbonate is—

$$CaCO_3 + Cl_2 + H_2O \rightleftarrows CaCl_2 + 2HOCl + CO_2$$

Assuming an excess of the calcium carbonate, both the weak acid HOCl and H_2CO_3 will react slightly with the calcium carbonate. The resulting solution then will contain suspended calcium carbonate, dissolved calcium chloride, hypochlorous acid, carbonic acid and their respective ions.

Completely chlorinated solutions of sodium bicarbonate would also produce hypochlorous acid—

$$NaHCO_3 + Cl_2 = NaCl + HOCl + CO_2$$

Such a solution would have the pH value of the weak hypochlorous acid buffered (modified) by carbonic acid. Again weak solutions of caustic soda or calcium hydroxide may be chlorinated to give hypochlorous acid.

$$NaOH + Cl_2 \rightleftarrows NaCl + HOCl$$
$$Ca(OH)_2 + 2Cl_2 \rightleftarrows CaCl_2 + 2HOCl$$

All solutions of hypochlorous acid are unstable, but for use in low concentrations of available chlorine and for use immediately after preparation, they afford a complete range of pH values on the acid side.

By selection of materials and concentrations, a complete range of pH on the alkaline side is available. Consider a one per cent available chlorine bleach, the making of which requires 8.6 pounds of chlorine per one hundred gallons of water. If a pH corresponding to a dilute solution of sodium hypochlorite and carbonic acid is desired, it may be prepared by chlorinating a soda ash solution of 12.8 pounds per hundred gallons. If one corresponding to a solution of sodium hypochlorite and sodium bicarbonate is desired, it may be had by chlorinating a solution of 25.6 pounds of soda ash to the hundred gallons of water with 8.6 pounds of chlorine. Or by chlorinating with 8.6 pounds of chlorine, a solution of 51.2 pounds of soda ash per hundred gallons, the residual alkalinity will be that of sodium sesquicarbonate. These statements may be expressed by the following equations:

(1) $\underset{\text{Soda Ash}}{12.8\text{ lb. } Na_2CO_3} + \underset{\text{Chlorine}}{8.6\text{ lb. } Cl_2} + \underset{\text{Water}}{H_2O} \rightleftarrows \underset{\text{Salt}}{NaCl} + \underset{\text{Hypochlorite}}{NaOCl} + \underset{\text{Carbonic Acid}}{H_2CO_3}$

(2) $25.6\text{ lb. } 2Na_2CO_3 + 8.6\text{ lb. } Cl_2 + H_2O \rightleftarrows NaCl + NaOCl + \underset{\text{Bicarbonate}}{2NaHCO_3}$

(3) $51.2\text{ lb. } 4Na_2CO_3 + Cl_2 + H_2O \rightleftarrows NaCl + NaOCl + \underset{\text{Carbonate}}{2(Na_2CO_3.NaHCO_3)}$

To continue to increase the pH, a residual of soda ash:

(4) $25.6\text{ lb. } 2Na_2CO_3 + 9.7\text{ lb. } 2NaOH + 8.6\text{ lb. } Cl_2 \rightleftarrows NaCl + NaOCl + 2Na_2CO_3$

or a residual of caustic soda

(5) $14.8\text{ lb. } 2NaOH + 8.6\text{ lb. } Cl_2 \rightleftarrows NaCl + NaOCl + NaOH$

Thus it will be apparent to the reader that with the available commercial alkalies, hypochlorite bleaches may be prepared through a pH range from acid (the dilute hypochlorous and hypochloric acid of chlorine water) through nearly neutral (as completely chlorinated weak calcium hydroxide solution) to one of the high alkalinity of residual caustic soda or lime, a range from pH 1.0 to pH 12.5 in increments as small as would ordinarily be desired.

It is well to note that the range indicated here is in the order of increasing stability. Chlorine bleaches of low pH are notably unstable, a characteristic associated with their rapid bleaching, as recognized by the textile bleacher in the application of his "buck sour." A buck sour consists of a bleach followed by a sour without intermediate washing, which amounts to bleaching in an acid hypochlorite bath.

This view that the chief variable in the characteristics of a bleach bath aside from concentration and temperature is in the pH value, applied to the consideration of multiple stage bleaching, of bleaching with chlorine water, chlorine hydrate or hypochlorous acid, etc., would eliminate premature and perhaps fruitless speculation as to the mechanics of the bleaching reactions. For instance, alkalies change, and even sometimes intensify, some of the organic colorants found in woody materials. When such a circumstance is encountered when using an alkaline bleach, it is but logical to try a bleach of lower pH value. An example is offered in a little problem on the bleaching of pecan shells. The paper shell pecans are of a light color, some lighter than others. A uniform light color of the pecan shells is a marketing feature of sufficient importance to the growers to justify the bleaching to a uniformly light and pleasing shade. Commercial sodium hypochlorite bleaches were tried without success. Bleaching powder solution gave unsatisfactory results. Residual caustic alkalinity are inherent in each of these. Sodium hypochlorite liquors must have residual caustic soda to insure reasonable stability and bleaching powder always has excess calcium hydroxide. Chlorine water, hypochlorous acid with the resulting hydrochloric acid, proved to be the effective reagent.

An understanding of the nature of the chlorine bleaches made by the various procedures eliminates a good deal of the questioning as to whether the ligninous materials contained in the pulp being bleached are chlorinated or oxidized, chlorinated by addition or by substitution or bleached by the several reactions going on simultaneously. The hypochlorite ion, OCl', is the same in all. The only important variable aside from concentration and temperature seems to be the condition of acidity or alkalinity.

It is hardly necessary to emphasize that a chlorine bearing bleach is a specific only for colorants that may be changed by oxidation or chlorination. Yet many a textile bleacher has augmented his trouble by attempting to whiten goods with bleach when the real source of the stain was a metallic salt or oxide upon which the effect of the bleach was to make the color all the more refractory.

Liquid chlorine, soda ash and caustic soda now come to the trade in a degree of purity which a few years ago would have been considered almost chemically pure. Limestone is as nature made it. When carefully burnt, quick lime or hydrate is as pure as the limestone from which it was made. In pulp bleaching the precipitation of metallic oxides may be minimized by using bleach of a low pH value. But with low pH is encountered the dilemma of suitable non-corrosive equipment. The court jester, it is said, on listening to a learned dissertation on the universal solvent, asked, "What will you keep it in?" Fortunately, this difficulty in practice is not of the magnitude and extent that laboratory considerations would lead one to believe because in large tonnage operations the ratio of surface exposed to the volume of material is relatively small. And again alloys are available that are relatively resistant to weak bleach liquor of low pH.

◆ If bleaching pulp, in spite of developments and research trends, must still be called an art, it would seem to be profitable to hold a clear picture of reagent behavior cleft of confusing detail. The hypochlorite ion is the essential agent, its characteristics modified by the presence of concomitant salts, but more especially, by the presence and concentration of hydrogen and hydroxyl ions. Then, having before us the classic procedure of Cross and Bevan for obtaining pure alpha cellulose and the accumulated observations on multiple stage and conventional lime bleaching, we have in pH control an important guiding factor.

The conservative bleacher has before him the materials to try remedial measures to the tried and true procedure. To the more venturesome are available materials to produce, for instance, superior Rayon grade pulp, whiter and stronger bleached kraft, or if economics justified even pure alpha cellulose. There is no evidence of or reason for a fatalistic attitude in the pulp and paper industry.

Calcium Hypochlorite for Bleaching of Pulp

FERRI CASCIANI and AXEL HEILBORN
Electro Bleaching Gas Company

◆ CALCIUM hypochlorite is the most important bleaching agent for wood-pulp. Probably over 95 per cent of all bleached pulp is prepared by the use of a solution of this chemical. The terms bleach and bleach liquor as commonly used in the paper industry are synonymous with calcium hypochlorite solution. Up until about 1920 almost all bleach liquor was prepared from solid calcium hypochlorite in the form of bleaching powder. Directly following the war, liquid chlorine began to be increasingly used for the manufacture of bleach liquor in paper mills, this because of the perfection of shipping facilities for liquid chlorine on a large scale. Chlorine then became cheaper to ship and easier to handle in the liquid form than absorbed in lime as bleaching powder; consequently, the use of liquid chlorine expanded tremendously, until today a relatively small amount of bleach liquor is prepared from the solid powder.

Bleaching powder is prepared by absorbing chlorine in hydrated lime. The lime is spread out in gas-tight chambers and exposed to the chlorine gas until the required chlorine content is reached. Powder is usually sold on the basis of 35 per cent available chlorine, but the actual test of freshly prepared bleaching powder runs between 36 and 38 per cent.

In order to insure reasonable stability against decomposition, a large excess of free lime must be present. The powder, nevertheless, loses strength gradually during storage, especially in warm weather. It smells strongly of chlorine and is bulky and unpleasant to handle.

When bleach liquor is prepared from the powder, a large amount of insoluble sludge remains, due mainly to the large excess of lime present. This settles to the bottom of the tank, leaving a clear bleach solution. Bleach liquor used in paper mills generally contains between 20 and 40 grams of available chlorine per liter. For rough control, Baumé tests of the liquor can be used for determining the strength. Figure 1, Curve A, shows the relation between the Baumé test and the strength of the liquor in grams per liter for liquor prepared from fresh powder. Liquor made from partially decomposed powder will contain less available chlorine for the same gravity. A more accurate control can be maintained by titrating for available chlorine, because in this way are eliminated variations in gravity due to temperature and to presence of excess chloride.

As already pointed out, there are several disadvantages connected with the use of bleaching powder in paper mills. Outstanding among these are: (1) expensive and bulky transportation, (2) comparative instability in storage, (3) inconvenience in handling in the mill, and (4) high sludge content, resulting in important settling and sludge-washing problems.

Practically all paper mills doing a substantial amount of bleaching nowadays use bleach liquor manufactured in the mill from liquid chlorine and milk-of-lime. Dry liquid chlorine for bleach-making is shipped in 16-ton single-unit tank cars or in one-ton drums on multi-unit cars of 15 drums capacity. Chlorine in this form is perfectly stable and can be stored indefinitely.

Either dry hydrated lime, purchased in 50-pound paper bags, or wet lime, slaked in the mill from quicklime, is used for bleach-making. When warm, mill-slaked lime is used, care must be taken that the temperature of the finished bleach liquor does not go above 90 deg. Fahr. Usually the lime is slaked in low, open pans and given ample time to cool off before it is used. In some cases the dry-slaking method is employed and

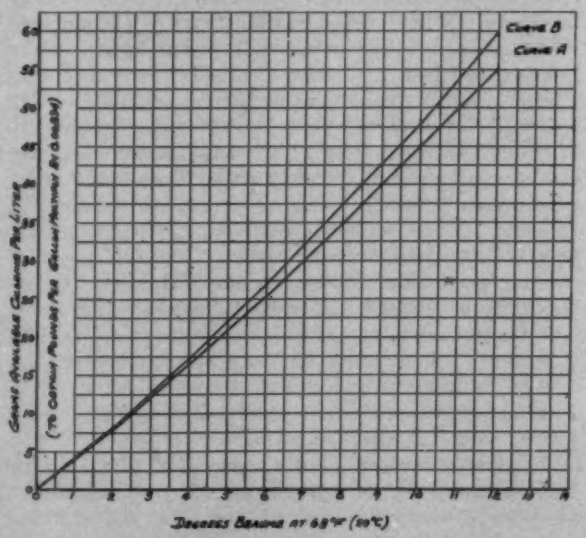


Fig. 1—Degrees Baumé versus grams available chlorine per liter for settled, fresh calcium hypochlorite bleach liquors. Curve A: Liquor made from good bleaching powder (approximate curve). Curve B: Liquor made from lime and liquid chlorine (accuracy plus or minus one g.p.l.); temperature correction approximately two g.p.l. per 10 deg. C.

most of the heat generated escapes in the form of steam. Lime for bleach-making should be high in CaO content and should have good sludge-settling qualities.

Various systems are in use for obtaining the necessary intimate mixing of the lime suspension and chlorine. In some cases, the liquid chlorine is introduced into the bottom of an agitated, open concrete tank containing the milk-of-lime. Another method utilizes a concrete tank without an agitator but with a centrifugal pump for circulation of the milk-of-lime. The lime also may be circulated through a tile-filled gas absorption tower into which the chlorine is introduced, or it may be

pumped from the top of a tank, the chlorine being introduced into the pipe-line, which then discharges into the bottom of the tank in such a manner as to provide agitation of the entire batch.

The chemical reaction formula is most conveniently written

$$2Ca(OH)_2 + 2Cl_2 = Ca(OCl)_2 + CaCl_2 + 2H_2O$$

In making bleach in the mill, it is essential that an excess of lime be present at all times, even at the point of chlorine introduction. It is common practice to test the batch with phenolphthalein during the course of the chlorination. This gives a red flash if lime is present. Even better control may be obtained by titrating a sample for excess lime at regular intervals toward the end of the chlorination.

For each pound of chlorine to be absorbed the quantity of lime required is 1.15 to 1.20 pounds of hydrated lime or 0.87 to 0.90 pounds of good quicklime, these figures referring to actual operation. In a carefully prepared batch of bleach, the chlorine will be 98.5-99.5 per cent available. In this respect, the absorption tower appears to give the best results inasmuch as it gives an excellent mixing, which prevents local acidity and provides an easy and efficient control of the alkalinity of the solution at the tower base. In this way, the chlorine supply can be controlled at all times and, if necessary, decreased toward the end of the chlorination.

The prepared batch is permitted to settle, and the clear liquor is decanted into a bleach storage tank.

Usually three or four batches are made in a tank before the accumulated sludge is washed and discarded. Failure to do this results in the slowing down of the sludge-settling rate and the increase in the decomposition of the liquor with which the sludge is in contact.

◆ Clear calcium hypochlorite liquor is usually greenish-yellow in color. However, occasionally very small amounts of manganese or iron impurities in the lime get into solution and change the color to pink or yellow-brown. Commercial liquid chlorine, being one of the purest large-tonnage chemicals (99.9 per cent pure), does not affect the color of the bleach. At room temperature, and in the absence of direct sunlight, calcium hypochlorite solution saturated with lime is remarkably stable. In practice, however, the lime in solution becomes neutralized by carbon dioxide from the air, and the decrease in alkalinity is accompanied by a decrease in stability of the solution. For this reason, bleach liquor should not be stored more than a few days.

The strength of bleach liquor is either determined with a Baumé scale (Figure 1, Curve B) or, more accurately, by titration with a reducing agent (thiosulphate or arsenite).

Hypochlorites are capable of entering into two separate types of chemical reactions; namely, oxidation and chlorination. In the presence of compounds susceptible to chlorination, hypochlorites react as follows:

$$2RH + Ca(OCl)_2 \rightarrow 2RCl + Ca(OH)_2$$

When acting as an oxidizing agent, hypochlorites release their available oxygen in this manner:

$$Ca(OCl)_2 \rightarrow CaCl_2 + 2O$$

While it is the oxidizing power of calcium hypochlorite that makes it valuable as a bleach for pulp, nevertheless, both chlorination and oxidation occur in the bleaching operation. Lignin left in the pulp is very easily chlorinated; consequently, when bleach liquor is first added to pulp, the color becomes darkened due to the formation of colored, chlorinated compounds. This reaction is very rapid and soon gives way to the oxidation reaction, which is accompanied by a gradual whitening of color. In addition to lignin, other materials removed or whitened in the bleaching operation include coloring matter (either originating in the wood or formed in the cooking operation) dirt and other foreign particles.

Unfortunately, the oxidation reaction does not limit itself entirely to so-called impurities in the pulp. Under certain conditions, the cellulose itself is attacked by

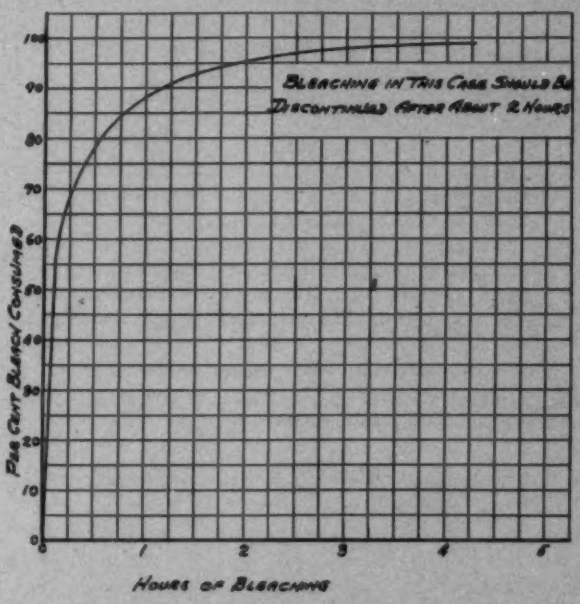


Fig. 2—Example of rate of bleach consumption in bleaching a sulphite pulp, single stage to a good, white color

the hypochlorite. It is possible, however, to control the conditions of bleaching, in order to keep this destructive effect at a minimum for the production of strong pulps.

The factors in the bleaching of pulp which govern the rate and type of reaction are the same as those which influence chemical reactions in general. Probably most important among these is *temperature*. The bleaching time necessary to arrive at a given whiteness is a direct function of the temperature; the warmer, the faster bleaching. In this respect, however, it is important to consider the fact that an excessively high temperature increases the destructive effect of bleach upon the cellulose fiber and also may cause decomposition of bleach to unavailable forms. Practice has demonstrated that at consistencies around 6 per cent the bleaching operation can be accomplished in a reasonably short time with a maximum temperature of 105 deg. Fahr. Temperatures above this should be avoided at all times. At higher pulp consistencies, lower temperatures should be used to prevent harmful action on the fibers. At consistencies of 15 to 20 per cent tem-

peratures above 85 to 90 deg. should not be employed.

At one time, practically all bleaching was carried out at a low *consistency* (5 to 6 per cent) in beaters, open tanks, etc. During the last decade the advantages of higher consistency bleaching have become apparent, and satisfactory equipment for handling pulp at such higher densities has been developed. Much bleaching

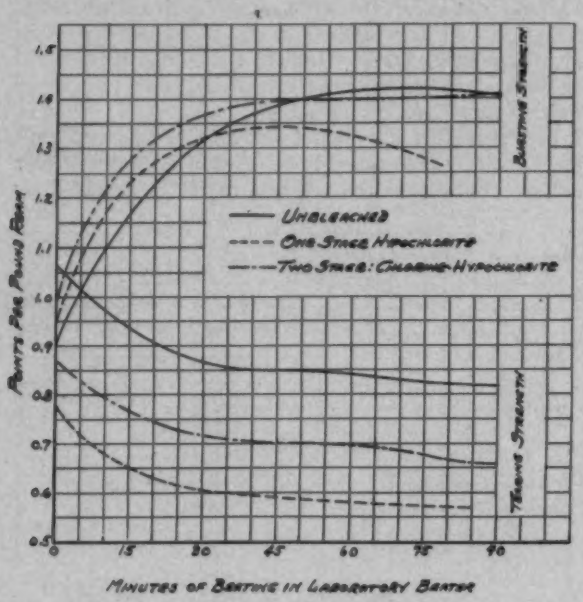


Fig. 3—Strength curves of a sulphite pulp of medium bleachability bleached to a good, white color

is now performed either in heavy-density, vertical type bleachers, capable of circulating pulp up to 20 per cent or more, in breaker-type engines for bleaching lapped or dried pulp at consistencies up to 10 per cent, or in high-density beaters at 7 to 8 per cent consistency. Inasmuch as the bleaching temperature at higher densities is correspondingly lower and the pulp volume small, one important advantage of high-density bleaching is the saving of steam. Another important advantage is the fact that, at high densities, shives and dirt in the pulp are much more readily removed, making for a cleaner product. This effect probably is due to the rubbing and flexing action on the fibers, which action is obtained only in high-density bleaching. In addition to these favorable points, it appears that the amount of bleach required to arrive at a given color is somewhat less than at low densities.

In ordinary bleaching, where no attempt is made to control the *alkalinity*, the pulp is alkaline during the early part of the operation, due to lime in solution in the bleach liquor and as a result of lime formed as a by-product of the early chlorination reaction. The lime, however, gradually becomes neutralized by carbonic acid and other compounds of acid nature formed during the oxidation stage. Near the end of the bleaching operation, therefore, the pH of the pulp will have dropped to about 6.5, at which point it is automatically buffered by the bicarbonate. The activity of the hypochlorite can be regulated by controlling the pH during the bleaching process. Addition of alum or an acid will shorten the bleaching time materially. Under these conditions, however, the bleach is active enough to do considerable harm to the fiber, and in addition the acid present exerts a destructive hydrolytic action upon the cellulose. Because of this and of the instability of hypochlorites when acidified, the bleach consumption is appreciably increased. On the other hand, it is possible to reduce the oxidation of cellulose to a minimum by the addition of some extra alkali (lime or caustic soda) to keep the pulp decidedly alkaline throughout the bleaching period. Although the bleaching time will be lengthened somewhat by this method, it is, nevertheless, economically carried out, when the best possible pulp quality is desired.

In order that uniform bleaching may be assured, it is essential that good *agitation* be provided to bring about thorough mixing of bleach with pulp and of steam with pulp. Poor mixing—particularly in the beginning—will result in local overbleaching or local overheating with the attendant harmful effects upon the fibers.

Some advantages can be realized by dividing the regular hypochlorite bleach process into two stages, using an additional washing between stages. By this method, it is possible to save 15 to 25 per cent in chemicals, to produce a whiter color of hard-bleaching pulps, and very often to arrive at this color with less loss in strength than by the single-stage method. The amount of bleach used in the first stage is proportional to the hardness of the pulp and varies between 40 and 75 per cent of the total requirement. The maximum bleach saving is realized by using the amount of bleach in the

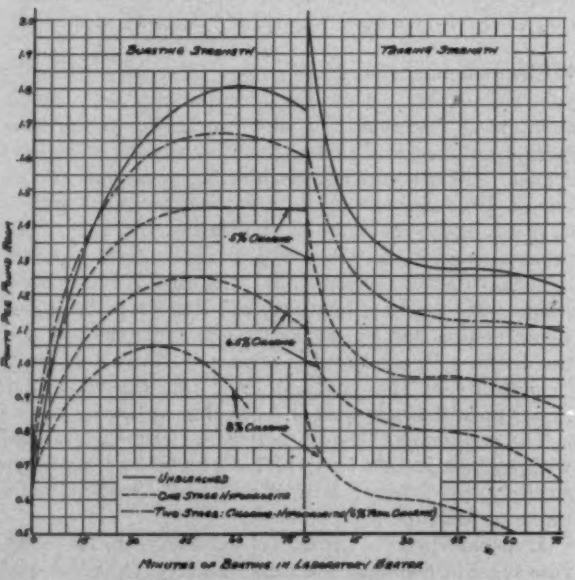


Fig. 4—Strength curves of a kraft pulp of medium bleachability

first stage which produces the darkest colored wash water.

Since the successful introduction of direct chlorination of pulp in the industry within recent years, interest in the two-stage hypochlorite method has gradually dropped off. The reasons are quite evident. By the chlorination method of treating pulp, a saving in chemi-

cals over one-stage bleaching of 20 to 40 per cent is realized, and a pulp of superior whiteness is attainable with little or no loss in strength in the case of even the hardest pulps.

◆ Inasmuch as many physical properties of wood-pulps, such as strength characteristics, softness, opacity, ease of hydration, etc., are affected by the degree of cooking, it is also natural to expect that pulps intended for different usages will vary considerably in bleachability. Easy-bleaching sulphite pulps require from 3 to 5 per cent chlorine in the form of hypochlorite; sulphite pulps of average bleachability require from 5 to 7 per cent chlorine; and many hard pulps up to 10 per cent, with some particularly raw pulps running as high as 13 per cent.

Well-cooked, so-called bleachable kraft pulps require 5 to 8 per cent chlorine as hypochlorite. Other harder kraft pulps usually take about 10 to 12 per cent, while a few may run as high as 15 per cent. Soda pulps made from hardwoods are usually not cooked with the intention of preserving strength, and such pulps require about 4 to 6 per cent chlorine. In a few mills, where softwoods are cooked by the soda process, a hard pulp is produced in order to preserve as much strength as possible, necessitating the use of more bleach.

Chlorinated sulphite pulps will require 2 to 3 per cent chlorine as hypochlorite, and properly chlorinated alkaline-cooked pulps will run still somewhat lower in bleachability.

The effect of hypochlorite bleaching upon the strength characteristics of pulp is dependent, to a large degree, upon the type of pulp in question. All pulps prepared by the alkaline processes (kraft or soda pulps) lose considerable strength when bleached by hypochlorite directly. On the other hand, if these alkaline pulps first are given the proper direct chlorination treatment, they can be bleached successfully to a satisfactory white color with only little loss in strength.

Sulphite pulps do not lose as much strength in hypochlorite bleaching to a white color as do the alkaline pulps. Soft, well-cooked, easy-bleaching sulphites, requiring only little bleach, lose little or no strength in the bleaching operation—the weakening of the fibers having already taken place in the relatively aggressive cooking operation. In general, the harder the pulp (lighter cooked), the more loss in strength will take place in bleaching it to a good white color. Bleaching to cream colors—semi-bleaching—is usually not accompanied by any loss in strength; in fact, the maximum bursting strength may actually increase some. Properly chlorinated sulphite pulps can be bleached to a high degree of whiteness with little or no effect upon strength.

◆ The chemical quality of cellulose is most commonly measured by the determination of alpha-cellulose content and of copper number. Ordinary bleaching is usually accompanied by a lowering of the alpha-cellulose content and increase in the copper number, this due to

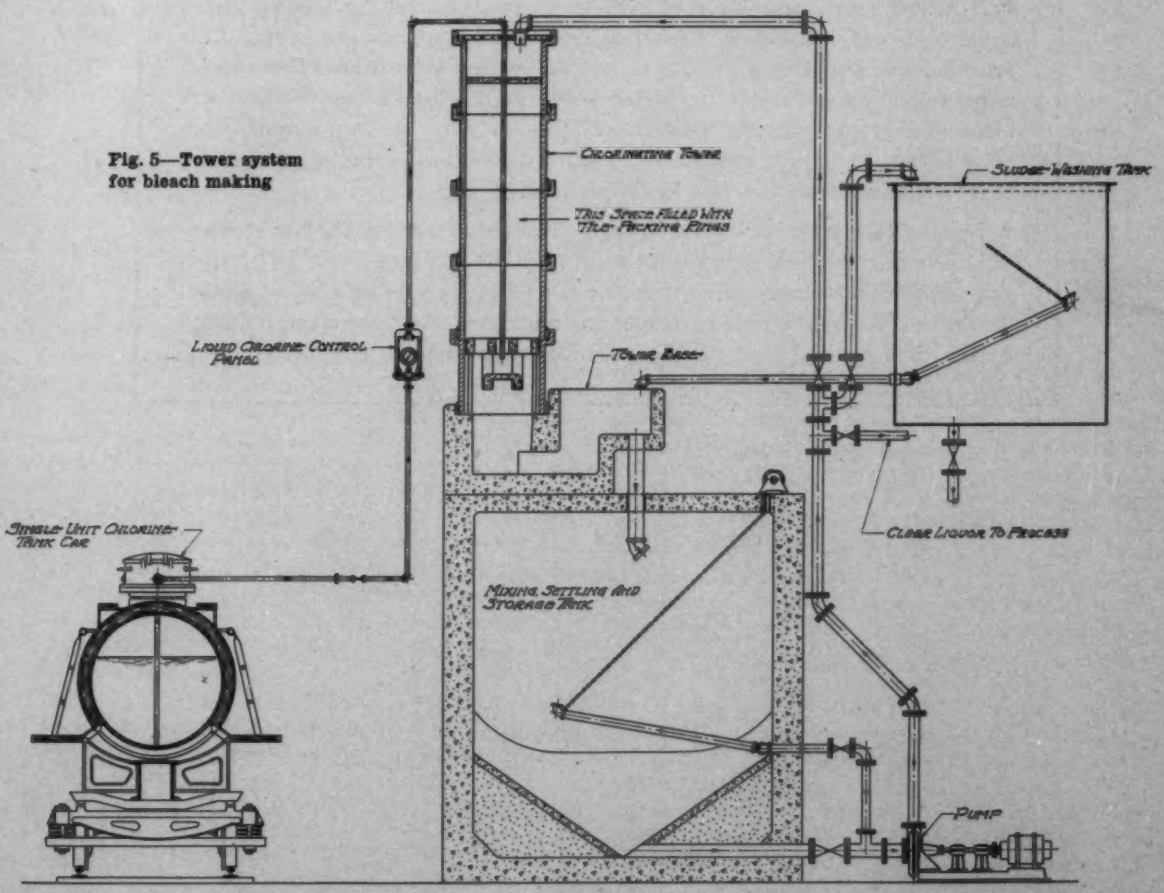


Fig. 5—Tower system for bleach making

the formation of a small amount of oxy-cellulose and hydro-cellulose. Under acid bleaching conditions this effect is pronounced. It is possible by maintaining alkaline conditions during bleaching to greatly minimize this chemical degradation. Special high quality pulps, produced with the purpose of maintaining a high alpha-cellulose content (over 90 per cent) are always bleached under a decidedly alkaline condition. Another point to remember in this connection is that the higher the alpha-cellulose content of the bleached pulp, the more stable will be the color of the pulp—as determined, for example, by limited exposure to sunlight.

Since lignin and other compounds present in unbleached pulp are rendered soluble during the bleaching and are washed out of the pulp, there is a loss in weight as a result of this operation. It is reasonable that this so-called shrinkage varies with different pulps and is proportional to the amount of lignin and other impurities present in the pulp. Accordingly, the shrinkage for hard-bleaching pulps will be appreciably higher than for soft, easy-bleaching pulps. In addition, whenever pulp is overbleached, some cellulose is broken down and goes into solution, in which case an additional shrinkage can be expected. Actual figures for loss in weight during bleaching should fall within the range of 2 to 3 per cent for the very easiest bleaching pulps up to 7 to 8 per cent for the hardest cooked pulps. These figures do not take into consideration any possible mechanical losses. Such losses in the washing of bleached pulp, however, are maintained at an insignificantly low figure, with such modern efficient washing equipment as the continuous vacuum-type rotary washers.

◆ A British patent was issued in 1798 to Charles Tennant for making bleach liquor by passing chlorine into a well-agitated mixture of lime and water. This process, made use of by a number of Lancashire bleachers without acknowledgment, was the basis of a suit for infringement. In this legal action, Tennant was non-suited on two grounds; namely, (1) process had been used several years prior to date of patent, and (2) agitation of limewater, an indispensable part of the process, was not invented by the plaintiff.

◆ Tennant took out a new patent in 1799. This patent covered the manufacture of bleaching powder through the action of chlorine on slaked lime. In partnership with several others, Tennant during the following year established a plant for the production of bleaching powder and other products of the alkali industry. At this time was laid the foundation for the bleaching powder industry.

Lime for Pulp Bleaching

O. L. COOK*
Lehigh Lime Company

ONLY a few years ago most bleaching in the paper mills was done with bleaching powder, this product being produced by the absorption of chlorine gas into dry hydrated lime. In this process, not more than 80 per cent of the lime present actually combined with the chlorine, the other 20 per cent being required to stabilize the bleach. As the maximum amount of chlorine gas absorbed was approximately only 38 per cent, more efficient and economical methods have since been developed. At present, chlorine gas is compressed and chilled to liquid form and shipped to the paper mill in drums and tank cars, the lime being secured more or less locally in oxide or hydrated forms, and at much lower rates than when made up as bleaching powder.

If the lime is in oxide form, it is slaked at the paper mill and made into a milk-of-lime, some mills slaking and making up as much as ten tons of lime at one time. Mills having large and continuous requirements, find it more economical to purchase bulk or quick lime having an available CaO content of from 90 to 94 per cent, and, wherever possible, this lime is used direct from the car, as any lengthy storage means loss through recarbonation in addition to double handling costs.

The advantages of hydrated lime, containing only 70 to 71 per cent available CaO, and packed in 50-lb. paper bags, are: (1) greater ease in handling; (2) less loss in storage; (3) lower percentage of impurities; (4) freedom from grit and core; (5) usually superior physical characteristics, due to more scientifically controlled methods of hydration at the lime plant.

Conditions at the individual plant necessarily must determine the choice between hydrated lime and bulk, or quicklime, as it is sometimes called. Where bulk lime can be used, the disadvantages of excess grit and impurities, so injurious to pump propellers, can be offset by screening the milk-of-lime.

Given a high available CaO, the physical characteristics of the limestone from which the lime is made are all important. At best, lime is a highly variable product, largely because of the great range of differences in the raw stone from which it is produced, but partly because of scientific deficiencies in existing production methods. Production methods can affect these inherent characteristics over a wide range, and it is regrettable that the lime manufacturers have not been able to give more attention to these facts. The close margin of profit (where there is a profit) has minimized the possibilities of scientific research through which these facts could be determined.

There are a number of differences in performance of lime used for the manufacture of bleach liquor, all of which would bear study. One of these is the tendency of limes higher in calcium to settle badly. In this connection, limes several per cent lower in calcium have been known to be more absorptive and at the same time to possess superior settling qualities. Also, and equally as strange, the slower settling limes are apparently more reactible, giving greater absorption of chlorine and more stable bleach liquor. Where limited settling capacity does not make a fast settling lime necessary, better results often can be secured by using a slower settling lime. If the underlying reasons for these results, as well as other so far inexplainable results, could be determined, much could be accomplished toward making lime a more efficient and dependable chemical material.

The physical characteristics of lime being largely intangible, the chemical characteristics are generally the determining factor in the selection of lime for bleach. Usually a minimum of available CaO in hydrated lime is specified with a minimum of impurities, particularly magnesium.

Representative Analyses

High Grade, High Calcium Bulk Lime

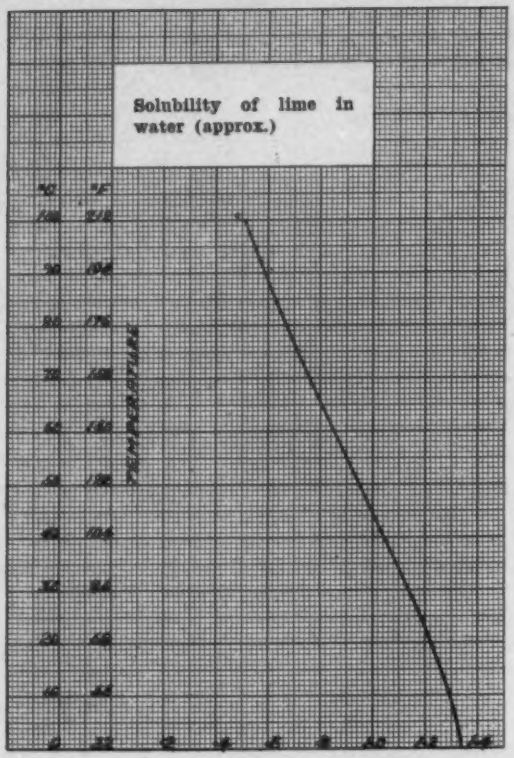
Total CaO	96.58
Available CaO	93.02
Calcium carbonate or core	.95
Silica	.56
Iron oxide	.12
Alumina	.28
Magnesium oxide	.86
Sulphur trioxide	.42
Moisture and undetermined	.26

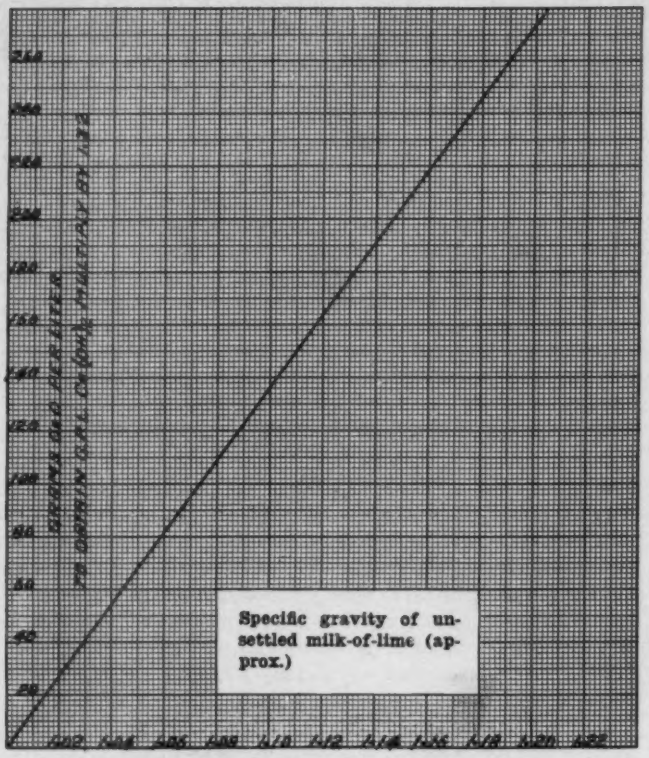
Hydrated Lime

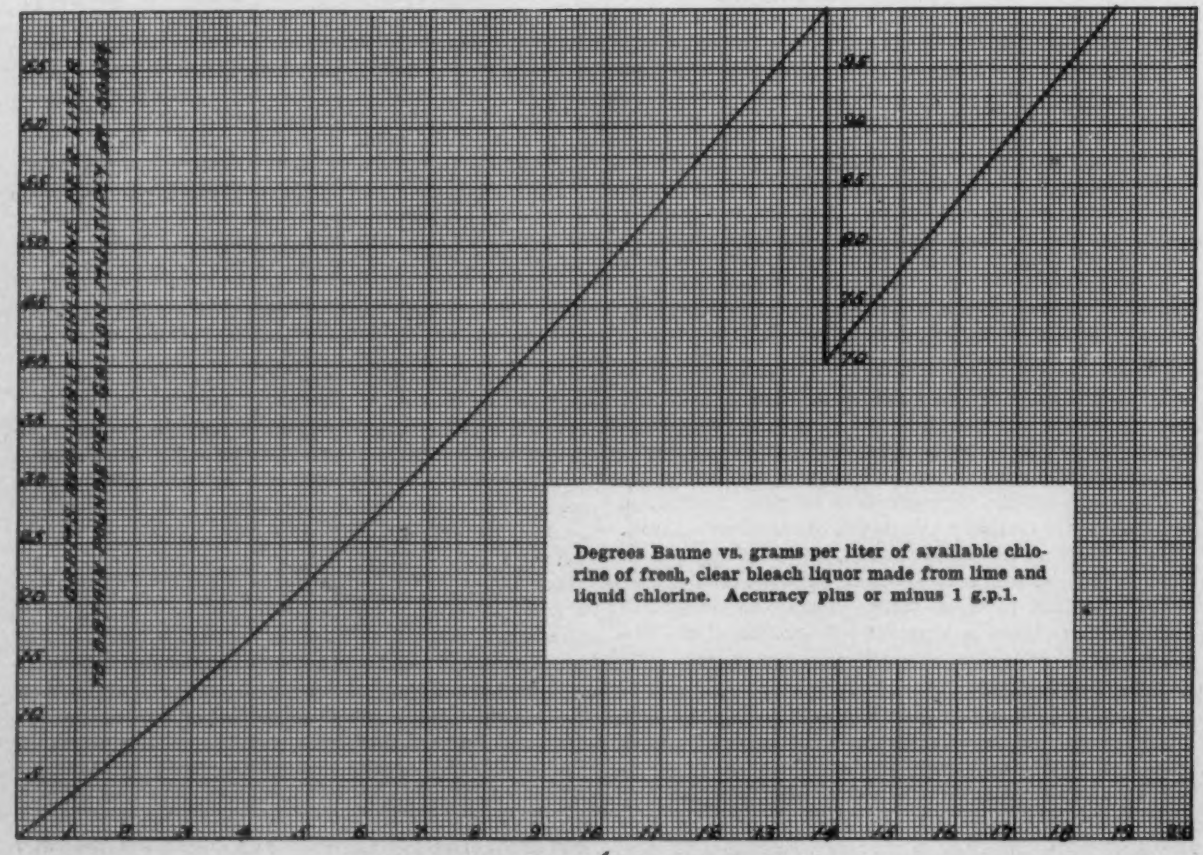
Loss on ignition	24.80
Silica	.72
Iron and alumina oxides	.68
Calcium hydroxide, total	95.87
Calcium hydroxide, available	92.50
Calcium oxide, total	72.55
Calcium oxide, available	70.00
Magnesium oxide	.72

In considering the preparation of bleach liquor or calcium hypochlorite, excessive agitation should be avoided both in the making up of the milk-of-lime and the bleach liquor, as it seriously affects settling qualities. If eruption of the sludge through gas or heat reaction is encountered, each subsequent settling will be less satisfactory with decreasing clarity of supernatant liquor. There will be a temperature rise of about 1 deg. C. for each 3 grams of chlorine added. If a calcium hypochlorite solution having a strength of 30 grams per liter of chlorine is prepared during the warm weather, with a starting temperature of 25 deg. C., the temperature will reach 35 deg. C. or 95 deg. Fahr., which temperature might be considered the upper limit for stability with solutions of this strength. This rise in temperature improves settling provided it is not carried to the decomposition point. The first batch of liquor will require an excess of lime to insure stability. This excess varies with conditions, the ratio of lime to chlorine running from 1.1 to 1.0 to 1.35 to

(*) Member of Non-Fibrous Raw Materials Committee (Lime and Limestone), T.A.P.P.I.

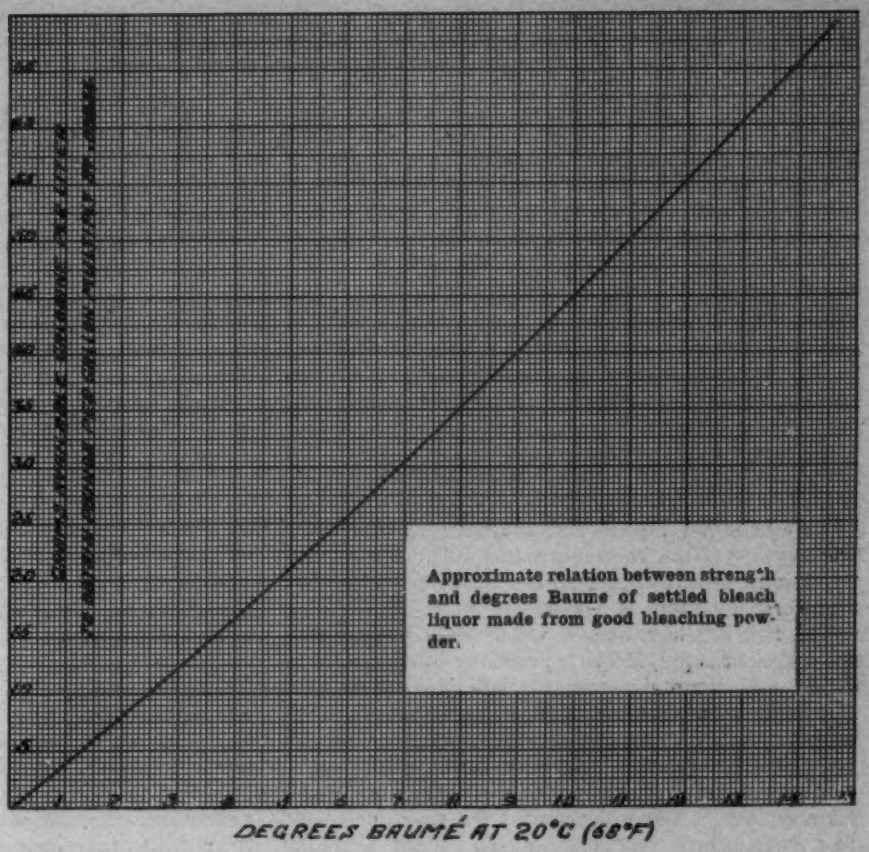

Solubility of lime in water (approx.)
GRAMS CaO PER LITER


Specific gravity of unsettled milk-of-lime (approx.)
SPEC. GRAVITY AT 20°C (68°F) d_4^{20}


Degrees Baume vs. grams per liter of available chlorine of fresh, clear bleach liquor made from lime and liquid chlorine. Accuracy plus or minus 1 g.p.l.
DEGREES BAUMÉ AT 20°C (68°F)

1.0. With successive batches, however, only enough lime need be added to correspond with the amount of chlorine increase.

This method materially reduces lime consumption. The amount of lime required for a solution having a strength of 30 grams per liter is about 2¼ lb. per cubic foot. As lime absorbs practically its own weight of chlorine, this will mean about 2¼ lb. of chlorine per cubic foot. Chlorine can be absorbed at the rate of 400 to 500 lb. per hour in a tank having a capacity of 1,800 cubic feet. The chlorine usually is injected tangentially into the bottom of the tank direct from the tank car, and unless requirements are large, ordinary agitation is sufficient. Sometimes a circulating pump is used to draw the liquor down from the top of the tank.



Approximate relation between strength and degrees Baume of settled bleach liquor made from good bleaching powder.

When a high grade lime is available, the efficiency of the present day liquid chlorine system is very high, delivering up to 99 per cent of the chlorine with which it reacts to the bleachers. While it cannot be considered as conclusive, the more dense a lime is when hydrated, the more useful it is likely to be, and the greater its ability will be to stand a high percentage of impurities without giving excessive sludge. A lime when hydrated which does not bulk, dry, over 200 cc. or 100 grams is under some conditions to be preferred over limes which bulk to 250 cc.

A useful test of lime to be used for chlorine bleach is as follows: Mix 40 grams of hydrated lime with 1,000 cc. of water in a glass cylinder. Then pass in approximately 30 grams of chlorine, using a capillary tube as a stirring rod. The gas should be injected at a rate resulting in a temperature rise of not over 1 degree every three minutes. After obtaining a 10-degree temperature rise, the solution should be allowed to settle and the depth of sludge noted at the end of fourteen minutes. (Fourteen minutes settling in a 14-inch cylinder, for example, would correspond to two hours settling in a 10-foot, three meter tank, the temperature of which would approximate 30 deg. C.) Then pour off 800 cc. of clear solution; add 30 grams of hydrated lime and from 24 to 27 grams of chlorine, being careful not to over-chlorinate, bringing the solution up to 1,000 cc. again, and to a temperature of 20 deg. C. This process is repeated to the third batch into which enough chlorine should be added to almost reduce the excess of lime, but not to the over-chlorination point. Up to this point, 100 grams of hydrate will have been used, and if 85 grams of chlorine have been absorbed, the lime being tested can be considered of very good quality. Some limes of exceptional quality will show a higher absorption than this. Also a good lime should not show more than 20 per cent total sludge.

The total and available chlorine in this solution should be determined and the last batch allowed to stand on the sludge for about 24 hours to make sure the lime does not possess characteristics which would tend to cause undue decomposition. The occurrence of a pink color in bleach solutions due to traces of manganese does not of itself indicate anything wrong.

Some of the paper mills have adopted a two-phase bleaching process in which (in addition to the use of calcium hypochlorite) there is a direct application of chlorine to the pulp, the excess chlorine being neutralized with lime. Usually the same lime is used for this purpose that is used for bleach liquor.

Water Considerations in Pulp Bleaching

DeVANE HAMILTON
Weyerhaeuser Timber Company (Pulp Division)

◆ IN THE manufacture and preparation of pulp there are numerous factors that claim considerable interest and attention. Among these are the various conditions in the cooking process, such as the strength of the cooking liquor; the maximum temperature and pressure in the digester, blow pit washing, the screening consistency; the type and cut of the screen plates, and others, including water considerations in pulp bleaching—not only in the washing process but in the manufacture of bleach liquor; and finally, in the drying or wet lapping of the finished product. Throughout this operation the essential medium of preparation and transference of pulp is water.

The first consideration of water for a pulp mill is the source of supply. There are many of these—lakes, rivers, and mountain streams. The ideal source for the water is one that will assure a large supply at all times, and will not be subject to any but seasonal changes in temperature, alkalinity, turbidity, color, and pH value. A supply of this nature will assure a uniform quality of water throughout the year due to the fact that uniform treatment can be maintained. If the supply is not subject to sudden radical changes, control of the filter plant will be much simpler and, therefore, easier. Sudden changes may not be detected immediately and a large amount of improperly treated water may enter the system.

Mountain streams are subject to quick changes, and, on the whole, present difficulties as a source of supply. They are influenced by weather conditions and such streams have been known to rise in turbidity from ten parts per million to several thousand in a few hours after heavy rainfalls.

High concentrations of mineral matter, vegetable coloring matter due to drainage from peat beds, dissolved organic material due to stagnation and effluent from other plants, and municipal sewage are objectionable in the supply. Waters of this nature are hard to treat and usually call for high chemical dosages for sterilization and floc formation, thereby increasing the cost of preparation of the water for plant usage.

◆ Another objectionable feature is a high plankton count or presence of biological micro-organisms. In addition to the usual chemical treatment, copper sulphate is utilized to kill these organisms. Water with a high plankton count, if not properly treated, will be difficult to filter. Plankton will accumulate on the filter beds and decrease the rate of filtering and the length of time filter beds are in service between washes. The cost of the copper sulphate and of the extra wash water will increase the cost of operation in addition to making it more complicated.

Water from large lakes usually contains quantities of plankton. This is true also of river water in warmer seasons when the temperature and alkalinity of the water is higher, such conditions being favorable for the growth and increase of plankton.

Unless carefully controlled, all of these conditions—high mineral content, color, dissolved organic matter, plankton count, and varying pH value, and temperature—will result in a finished water that will not be uniform from time to time. Since the quality of bleached pulp is dependent to a great extent upon the washing process, it follows that non-uniform water will give non-uniform pulp.

◆ The bleaching process that will be considered is the modern multi-stage process using a chlorine-hypochlorite treatment—the unbleached pulp at low consistency being treated with chlorine in the first phase and neutralized in the last part of this period with lime. This is followed by a washer, a thickener, a repulper, and a temperature controller. The semi-bleached pulp at high consistency is treated with hypochlorite bleach liquor in the second phase using caustic as a pH control agent. The pulp is again washed and put through a riffling and screening system after which it is ready for the finishing machine.

In the bleaching operation the temperature of the water probably is the most important factor. It affects not only the bleach liquor but the control of the bleaching. If the bleach liquor is made up to a set standard strength of available chlorine and then transferred to storage tanks until needed, it is more likely to remain practically constant if it is cool than if it is warm due to less loss of chlorine in a cool solution. The result is a saving in chlorine and a better control in the second phase of bleaching resulting from a uniform bleach liquor at all times. Also the temperature of bleach liquor is one of three things that determine the temperature in the second phase. A high temperature in this phase will increase the rate of bleaching but will make control much more difficult, while a low temperature slows the reaction and makes control easier. The optimum temperature for a good production with good control usually is determined and set as a standard. The three factors referred to above are:

(1) The temperature rise brought about by friction from the mechanical agitation of high consistency stock in the bleacher and the heat of chemical reaction.

(2) The temperature of the bleach liquor.

(3) The initial temperature of the high consistency stock entering this phase.

Temperature rise due to friction and heat of chemical reaction is practically the same for the same type of pulp and same bleaching time and can be considered as being constant.

The temperature of the bleach liquor, while it is largely governed by the temperature of the dilution

water, also is affected by the temperature of the lime slurry used in making it and the length of time the liquor is in storage before being used. If a regular schedule is followed from day to day in making the liquor, its temperature should vary but a few degrees.

With the friction and bleach liquor temperatures practically constant, it follows that the initial temperature of stock entering the second phase will have to be such that a combination of the three will give the standard set as maximum in the second phase.

The initial temperature of pulp needed is arrived at by means of the temperature of the wash and make-up water before the thickener and a hot water shower after the thickener. This means that the temperature of the water should be slightly below the second phase initial temperature. White water generally is used on the first washer and its temperature is a few degrees higher than that of fresh water, depending upon the temperature of the air. Therefore, the fresh water temperature must be that much lower than the second phase initial figure.

◆ After each phase of bleaching, it is necessary that the pulp be washed thoroughly to remove the soluble chlorination and oxidation products of the reaction in the bleacher. Washing removes the degraded materials and leaves the cellulose in a more purified condition for the succeeding phase. The pH value of the fresh water used in washing is important, especially after the second phase bleaching in which caustic is used as a pH control agent. Cellulose fibers adsorb caustic and do not readily release it. If the wash water has a low pH value, it will take out more caustic than if on the alkaline side, but there is a drawback in having the pH of water too low. This is the effect it will have on any iron piping in the mill, as well as the accompanying increase in iron content of the water from this piping. The optimum pH value is the neutral point or slightly on the alkaline side.

Theoretically, a high alkalinity content of the water will reduce its washing efficiency, especially with regard to the removal of the above mentioned excess caustic. Actually, in most cases, the difference between water of high and low alkalinity, measured in parts per million, will be so small that a decrease in washing efficiency will not be noticeable.

The color in water used to wash bleached pulp should be practically zero. Bleached pulp on the alkaline side readily takes up vegetable coloring matter from the water. Since the color of bleached pulp is thought of in terms of per cent whiteness, this percentage will be lowered by any coloring matter taken up by the pulp.

Like color, the suspended solids or turbidity in wash water should be zero. These suspended solids are so small that once they are mixed with the pulp there is little chance for them to be removed because they will not settle out in the riffling system and in screening will pass through the screen plates with the pulp. This will increase the dirt count in the pulp and lower the color.

Iron in water in the wet sheet entering the drying machine remains in the pulp after it is dried. The effect this iron has on the quality of the pulp may not become apparent until some time after it is dried but eventually it will lower the color of the pulp and also tend to affect the dyeing process when the pulp is being made into paper. Naturally, the per cent of iron in the filtered water should be very low.

Pulp is an excellent medium for the growth of micro-organisms of unicellular composition. These organisms, if allowed to enter the system, will increase until they assume serious proportions and should be checked immediately. Gelatinous accumulations of the growths, particularly where a slow flow permits its accumulation, forms slime. These micro-organisms belong to the bacteria family and have the peculiar property of thriving in the presence of cellulose. Slime spots impair the quality of the pulp which results in later difficulties in the processing of pulp into paper and causes plugging of screens and wires reducing their efficiency. These troubles often necessitate a shutdown for the purpose of cleaning out the system.

Copper sulphate, chlorine, chloramine and other treatments have been used to combat and eliminate slime. The chloramine treatment has been used very successfully in some operations and in others where chlorine and chloramine treatment have both been used it was found that the chloramine treatment gave the better result with a reduction in quantity of chlorine necessary to 30 per cent of the original quantity when it was used alone. This treatment was used in the mill system. But the logical treatment is to use chloramine at the filter plant and kill the organisms before they come in contact with the medium which favors their growth.

Chloramine treatment has another advantage in its favor. Water treated with chlorine in the form of chloramine will retain a residual of chlorine longer than that treated with chlorine alone. If the chlorine residual is retained longer, it is reasonable to expect that it will be an added safeguard in that it will act on any slime-forming organisms that are introduced by the raw materials.

◆ Utilization of white water results in cheaper operation of the plant. Its use decreases the amount of water that has to be filtered daily. Flow and usage of water runs counter-current to the flow of pulp so that the freshest water is used in the stock that is nearest the finished stage. White water from the fourdrinier wire may be re-circulated to the machine head box or it may be used as dilution water in the riffler flow box. If it serves as the latter, it may be used again when it comes off the bleached pulp deckers after the bleached pulp screens. For this second usage, it may be pumped from the decker sump back to the washers in the bleach plant.

In the bleach plant, white water can be used as make-up water in the washer head box and as a breaker shower to help remove the cake from the drum. It also may be used in the washer showers but fresh water at this point will give better removal of the soluble products. Too much white water should not be used because it contains a large per cent of soluble impurities by the time it returns from the finishing end of the mill, being utilized once or twice on the return flow.

Water used per ton of bleached pulp varies within wide limits, but it should be sufficient at all times to insure as pure and clean pulp as is practicable.

Buffered Bleaching

C. T. HENDERSON
Westvaco Chlorine Products, Inc.

◆ MECHANICAL buffers are well-known and often necessary contrivances. Chemical buffers are just as useful, but not quite so common, or perhaps we should say not so well recognized. Chemical buffers often are used unknowingly.

For several years past, the trend has been away from the old-fashioned straight bleaching in either one or several stages and the substitution of a stage of direct chlorination followed by bleaching in the same old way to secure the desired color. It is an acknowledged fact that this chlorination process reduces the total quantity of chlorine required—but why? If chlorine always acted in the same way, such questions could be answered easily—but it does not.

Chlorine may act indirectly as a bleaching (oxidizing) agent by forming compounds containing oxygen in readily releasable form, as, for example, sodium hypochlorite (NaOCl) which bleaches by releasing oxygen and forming salt (NaCl + O).

Again, chlorine may form direct addition compounds. The simplest of these is formed when hydrogen is burned in an atmosphere of chlorine and forms hydrochloric acid (H + Cl = HCl).

When chlorine reacts with organic substances, it generally does so by substitution. That is to say, it takes the place of an atom of hydrogen in the hydrocarbon organic compound and also combines with the hydrogen so released.

The simple and sufficiently accurate explanation of the action of chlorine on unbleached pulp is that soluble compounds of chlorine and coloring matter are formed by substitution, that these compounds can be washed out and that less chlorine is required to form them than to bleach them.

In any of these substitution reactions, one-half of the chlorine used enters into the new compound formed and the other half goes into the formation of hydrochloric acid. This accounts for the high acidity developed in straight chlorination.

The chlorine lignin compounds normally formed are soluble only partially in acids. For this reason, alkali must be added and the pulp washed after chlorination and before bleaching, even though acid-proof equipment is used and the acid removed before washing.

There are chlorine lignin compounds which are soluble either in acids or alkalis. If the reaction between the pulp and the chlorine is properly buffered, these are the compounds which will be formed. They are more easily removed by washing and are preferable for this reason.

In practice, after chlorination, there is added to the pulp 9/10 pound of quicklime, either in the form of hydrate of milk-of-lime, for each pound of chlorine which has been introduced. This lime serves the dual purpose of neutralizing the hydrochloric acid which has been formed, and making the pulp alkaline so as to render the coloring matter soluble.

In the buffered bleaching system, this hydrochloric acid is neutralized before it is formed, so to speak. This is accomplished by passing the chlorine, with water, through a hypochlorous acid tower in which the chlorine, which would go to hydrochloric acid and require neutralization later, is converted to calcium chloride and the rest of the chlorine converted to hypochlorous acid which will form addition compounds with pulp coloring matter, that is, react without producing acid. These addition compounds are soluble in either acids or alkalis, therefore, can be washed out more readily than direct chlorination products. And so this forms a reaction buffered against acid production and buffered to direct the formation of addition rather than substitution compounds.

The accompanying diagram illustrates the method of incorporating this buffered bleach idea into a practical bleaching system.

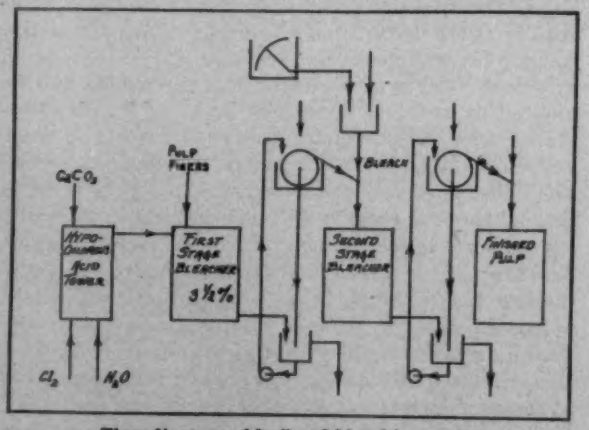
Chlorine and water are introduced into the bottom of the hypochlorous tower which is filled with limestone crushed ⅝ inch to dust. The water and chlorine passing upward through this tower react to form calcium chloride and hypochlorous acid.

This tower effluent overflows continuously at the top and mixes continuously with the deckered stock.

The consistency of this deckered stock is usually about 4¼ per cent and, when mixed with a sufficient amount of hydrochlorous acid (tower effluent) to represent 65 to 80 per cent of the total chlorine required for bleaching, the consistency will be reduced to about 3½ per cent. At this consistency, the stock goes into the first stage bleacher which must provide a detention period of 30 to 45 minutes.

There is a slow moving agitator in this first stage bleacher, not so much for agitation as to prevent short circuiting. The stock passes out of the first stage bleacher continuously into the sump of a vacuum type washer where its consistency is reduced to about 0.6 to 0.8 per cent. At this consistency it is pumped into the washer vat.

The drainage on the washer brings the consistency up to about 10 per cent, after which there is a displace-



Flow diagram of buffered bleaching system

ment wash with fresh water which removes practically all of the coloring matter which has been made soluble.

The washed pulp, at about 10 per cent consistency, now passes into the second stage bleachers where it is brought to color with calcium hypochlorite.

Where the highest color is not essential, the second stage also may be operated continuously, but where color requirements are exacting, it probably will be necessary to operate the second stage as a batch system to iron out the differences between individual cooks.

The hypochlorous tower is so designed that the upward velocity of water is not sufficient to carry out insoluble matter. The insolubles are removed from time to time, during week-end shut-downs, by passing water, without chlorine, upward through the tower at a velocity which will lift the insolubles and carry them out the top. The operation is one which is much akin to that of back-washing sand filters and presents no more of a problem.

◆ In analyzing this system, it will be noted that chlorine *per se* never comes in contact with the pulp or with any moving mechanical parts. The tower is constructed either of concrete lined with acid-proof brick, like a Jenssen tower, or may be constructed entirely of acid-proof tile. In the first stage bleacher, it is not necessary to use acid-proof construction. In one instance, a first stage bleacher constructed of wood staves has been in service for about five years. The agitator mechanism need not be acid proof, but may be constructed of steel and given a coat of any one of the numerous protective paints available in the market to prevent rusting during shut-downs.

The vacuum filter after the first stage likewise need not be of acid-proof construction, but should be painted with a coat of protective paint to prevent rusting during shut-downs.

A water meter in the line feeding to the bottom of the hypochlorous tower, in combination with a continuous sampler in the form of a dribble cock out of the hypochlorous line between the tower and the first stage bleacher, gives a perfect record of the amount of chlorine used in the first stage.

The average sample of hypochlorous acid is titrated for available chlorine expressed in pounds per gallon or pounds per cubic foot. This figure, multiplied by the meter reading, gives the total number of pounds of chlorine which have passed through the tower since the previous meter reading.

Hypochlorous acid has about the same odor as bleach liquor. By placing the hypochlorous tower out of doors, or separating it from the rest of the mill by a suitable partition, the chances of chlorine escaping into the mill are entirely obviated.

Pulp bleached in this buffered system suffers practically no degeneration in physical characteristics. In fact, all properties, other than tear, are generally improved, but the tear sometimes will fall 3 to 5 per cent in bleaching.

The physical properties of a typical sulphite pulp before and after bleaching by this process might be tabulated as shown in the accompanying table.

These figures are on a bond basis which accounts for the high test. However, for purposes of comparison of the physical properties of the bleached and unbleached stock, the figures serve just as well as though they were expressed in the usual terms for sulphite.

		Beating Time		
Mullen		*60 Min.*	*80 Min.*	*100 Min.*
	Unbleached	187	205	220
	Bleached	224	217	203
Fold				
	Unbleached	8.9	18.4	10
	Bleached	17.0	34.0	29
Tear				
	Unbleached	506	583	582
	Bleached	568	525	540

The loss of fiber in bleaching, by reason of the elimination of strong acids in contact with the pulp, is remarkably low. It is much lower than that incurred in any straight bleaching systems, and considerably lower than that encountered in straight chlorination systems.

In the buffered bleaching system, the insolubles in the limestone are left behind in the tower and not introduced into the pulp.

Where either hydrated lime or milk-of-lime is introduced after chlorination, the insolubles are added to the pulp. They are not easy to remove and add to the ash content.

It will be interesting to note here the economics of the situation.

In the direct chlorination process, if it is assumed that 60 pounds of chlorine are introduced per ton of pulp in the first stage, and that the acidity is neutralized with hydrated lime, then 72 pounds of hydrated lime will be required per ton of pulp. At $10 per ton, this will cost 36 cents.

In the buffered bleaching system, if 60 pounds of chlorine per ton are used in the first stage, there will be consumed out of the limestone in the tower 45 pounds. At $4.00 per ton, this will cost 9 cents. Thus the difference in alkali cost will be 27 cents per ton of pulp bleached.

In a sulphite mill generally there will be enough spawls from the Jenssen towers to supply the hypochlorous acid towers, and since these spawls normally are thrown away, they may be charged properly to the hypochlorous acid system at handling plus grinding cost, which should not exceed $2.00 per ton. This will add another 4½ cents per ton of pulp to the saving arising out of the use of the buffered bleaching system.

One point worthy of serious consideration in this buffered bleaching system is the fact that the alkali supply is directly regulated by the chlorine introduced. It is not necessary to have alkali feeders. The tower always contains an excess of limestone which is replenished usually once a day. The amount of chlorine introduced into the bottom of the tower fixes the amount of limestone consumed without the use of any regulating whatsoever.

It may be said that experience shows that anything which can be accomplished with direct chlorination can be accomplished in a buffered bleaching system at lower installation cost and at lower operating cost, with the added feature of being practically fool-proof.

Chlorine *Handling* and Bleach *Make-up* Equipment

W. L. SAVELL, Technical Advisor
The Mathieson Alkali Works (Inc.)

◆ A GAS at atmospheric pressure and room temperature, pure chlorine readily liquefies at a temperature of 70 deg. Fahr. under a pressure of 84 pounds per square inch. Although it is a powerful oxidizing agent, it is practically inert to most of the common metals under these conditions in the absence of moisture. With water as vapor or liquid, chlorine reacts to form hydrochloric and hypochlorous acids in substantially the following manner:

$$Cl_2 + H_2O = HOCl + HCl$$

The presence of the moisture permits the hypochlorous acid to exert its strong oxidizing power and the hydrochloric acid to corrode common metals to form the corresponding chlorides of those materials contacted. This reaction often is observed when moist chlorine is in contact with iron. Regardless of which product resulting from the water-chlorine combination is considered as acting first, the final compound will be ferric chloride if an excess of chlorine is present, as for instance:

$$Fe + 2HCl = FeCl_2 + H_2$$
$$H_2 + HOCl = H_2O + HCl$$
$$2FeCl_2 + HOCl + HCl = 2FeCl_3 + H_2O$$

Essentially, the action may be indicated in this way:

$$3Cl_2 + H_2O + 2Fe = 2FeCl_3 + H_2O$$

The water may be considered as the carrier or activator of the chlorine.

Some metals are acted upon by chlorine in the dry state. Antimony and tin are outstanding in this respect. As the chlorine of these metals are liquid at and considerably below room temperature, it is obvious that they or their alloys should not be used in any equipment or apparatus in contact with chlorine wet or dry.

Iron, brass, bronze, nickel, monel metal, lead and the alloy steels, as well as most of the special acid resistant alloys, may be used in contact with dry chlorine at room temperatures. At elevated temperatures, however, none of the metals can withstand the vigorous attack of chlorine.

Lead, silver and Hasteloy C give satisfactory service with chlorine in contact with water. Lead is quite resistant to the action of chlorine, but is attacked to some degree at the surface in the presence of moisture. The low solubility of the lead chloride, formed especially when hydrochloric acid is present, creates a relatively passive condition. Where lead is alternately exposed to chlorine and an alkaline substance such as milk-of-lime, it will wear away as a result of the alternate formation and removal of the protecting chloride. A condition such as this exists at the open end of a lead pipe delivering chlorine to milk-of-lime in the production of bleach liquor. There it will be noted that a brown to black compound is formed on the lead pipe at all points in contact with the milk-of-lime and chlorine. This dark colored material is lead peroxide and is formed about as follows:

$$Pb + Cl_2 = Pb\,Cl_2$$
$$Pb\,Cl_2 + Ca(OH)_2 = CaCl_2 + Pb(OH)_2$$
$$Pb(OH)_2 + Cl_2 + Ca(OH)_2 = PbO_2 + CaCl_2 + 2H_2O$$

The film of lead peroxide is non-adherent and, therefore, does not serve to protect the lead surface upon which it may be found. In fact, there is some evidence

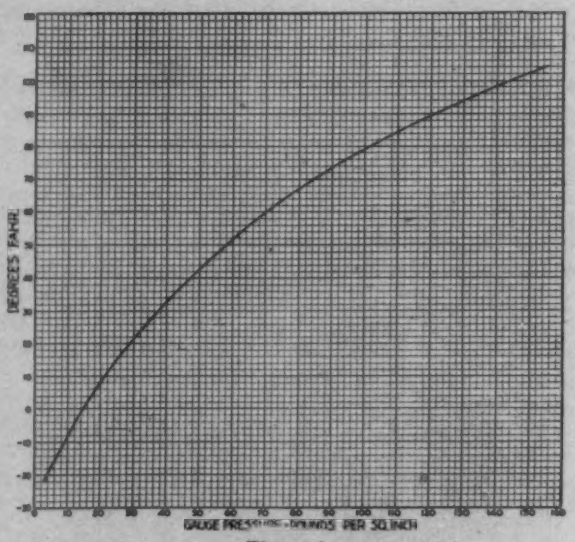


Figure 1

to indicate that there is some reaction potential which tends to induce further oxidation of the lead surface such as—

$$PbO_2 + Pb = 2PbO$$

Silver, Hasteloy C, and Duriron exhibit specific resistance to the action of moist chlorine or its solutions and equipment and apparatus made up of these metals give good service.

Chemical stoneware, vitrified brick and tile and fused silicia give perfect resistance to chlorine but because of their physical limitations the application of these materials to chlorine handling is restricted to conditions suitable. Fused silicia is the only available material showing excellent resistance to hot chlorine. Organic materials, on the other hand, reverse the form of metals and those that may be used with chlorine show better resistance to the solutions or moist chlorine than to the dry gas.

Pure gum rubber or hard rubber materials, as an illustration, oxidize more rapidly in contact with *dry* chlorine gas and because of rapid decomposition cannot be used at all with *liquid* chlorine.

All organic materials so far investigated react with dry chlorine and with the exception of the simple

methyl compounds give heavy, gummy substances as end products.

Although the methyl compounds not already chlorinated will react with chlorine, the end products—chloroform or carbon tetrachloride—are mobile, volatile liquids.

These facts are of interest as they indicate certain possibilities of equipment construction and certain precautions to be observed in operation. Briefly, these possibilities and precautions are: Rubber hose, hard rubber pipe and fittings, and rubber lined steel may be used satisfactorily with moist chlorine, chlorine solutions, or chlorine gas at low pressures. Dry chlorine eventually chlorinates all ordinary organics forming tacky gums; therefore, rubber or other organic equipment should not be used for handling dry chlorine. Also, lubricants should be used sparingly on valves, cocks or other fittings in contact with dry chlorine.

The methyl compounds are excellent cleaning agents for parts to be exposed to dry chlorine as any excess cleaner that may contact the chlorine will chlorinate to volatile liquids which will not tend to plug reducing valves or other fittings. Moreover, most of the chlorinated products of other organic compounds are soluble in chloroform or carbon tetrachloride.

◆ While chlorine is not a perfect gas in the scientist's meaning, it expands as do all gases approximately proportional to the increase in absolute temperature. In a confined space such as a pipe line, cylinder, ton container or tank car, this results in an increase in vapor pressure as shown in Figure 1.

With increasing temperature the liquid chlorine in confined space also expands reducing the gas volume above the liquid. The expansion rate for the liquid is .16 per cent per degree Fahrenheit increase in temperature.

The practical significance of this fact is noted in the specifications covering construction and filling of chlorine containers. Regulations established by the Bureau of Explosives and the Interstate Commerce Commission limit the filling of containers with liquid chlorine to 88 per cent of the water capacity. The other 12 per cent remains as gas space over the liquid. With increasing temperature, the vapor pressure increases as also does the volume of the liquid. As the temperature increases the liquid occupies an increasingly greater proportion of the total cylinder volume. At 165 deg. Fahr. the liquid will occupy practically the entire volume of the container. To prevent the development of tremendous hydrostatic pressures which would result beyond this point by further increase in temperature, cylinders and ton containers are equipped with fusible plugs which melt at 165 deg. Fahr. and allow the cylinder contents to flow into the air as a stream of gas. If this provision was not made the cylinders would explode violently at a temperature slightly above 165 deg. Fahr. These extreme conditions are not met in any rational use of chlorine, but do exist occasionally where cylinders or ton containers are exposed to high temperatures as in a burning building.

◆ These observations also point another precaution in connection with pipe line construction. It is occasionally desirable to close a chlorine pipe line by means of valves at opposite ends of the line. Liquid chlorine in the line is subject to the temperature changes of the atmosphere surrounding it. If no provision is made for expansion an increase in temperature will subject the line to a hydrostatic pressure sufficient to rupture it with the consequent release of the chlorine it holds.

Therefore, in any pipe section having valves on each end that may be closed either purposely or accidentally, an expansion chamber should be constructed, above the line, between the valves with a capacity at least 14 per cent of the pipe line volume in that section. In long pipe lines it is good practice to place an emergency shut-off valve at the end of each section of about 100 feet. Each section should have its own expansion chamber.

Standard chlorine containers are made in three designs and five capacities. Cylinders carry 105 pounds and 150 pounds net weight. A container of either of these sizes may be handled by one man and they are shipped in carlots in box cars or in less than carlots. The multi-unit tank car has a special frame with integral cradles into which are bolted fifteen containers each carrying exactly one ton of chlorine. These units are commonly unloaded at the receiving point and stored until needed indoors or outdoors as conditions dictate. Because of

Figure 2

Figure 3

their weight (the weight of the container alone is about 1250 pounds), special equipment must be used for unloading. The car frame is equipped with fixed hand rails which require lifting the containers from the car with a suitable bail or chain clamps and hoist (Figure 2). A crane used for this purpose should have a capacity not less than two tons.

When the multi-unit car is unloaded, the containers are generally stored indoors. In some instances, however, the full containers are stored outdoors in which case the containers and contents quickly reach a temperature approximately that of the atmosphere surrounding them. In cold weather this necessitates moving them indoors where the temperature is not less than 50 deg. Fahr. at least a day before the chlorine they contain will be needed. This permits the containers and contents to warm up sufficiently to build up a vapor pressure that will discharge the liquid contents in a period of forty-five minutes to one hour when the container is placed in service.

Although the ton container may be rolled on a smooth floor by one man, the transportation in the plant is greatly facilitated if a proper dolly or lift truck is used.

Stored on skids, the ton containers may be easily handled to and from dollies or lift trucks of corresponding height.

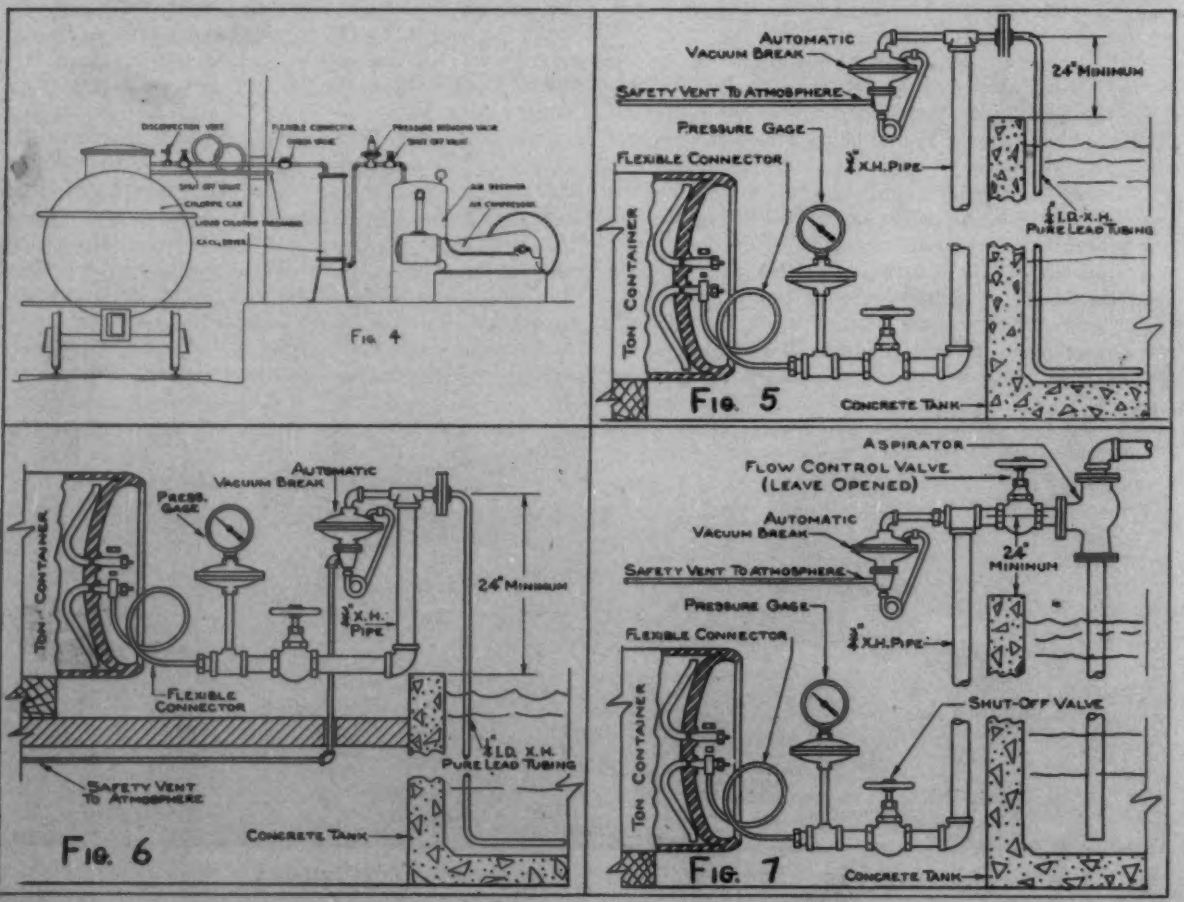
Ton containers are shipped only in carlots attached to the special car frame designed for them. They are never shipped in less carlot quantities with other freight. The multi-unit car travels as a tank car and pays a freight charge on the net weight of chlorine only.

The single unit car is one carrying 16 tons in the smaller size and 32 tons in the larger size in one forge welded tank built to I.C.C. specifications for Class 105 tank cars. The tank is insulated with 5 inches of cork.

In the dome are four discharge valves. The discharge connections are in duplicate, to permit flexibility in use and to provide alternate equipment for emergency conditions. The two valves in line parallel to the car length are connected to eductor pipes that extend into a shallow well in the center of the tank bottom. Chlorine as liquid is discharged through either of these valves.

Each eductor pipe is equipped with a ball check at the bottom end balanced to act if the flow of liquid from the car exceeds a rate of 5000 pounds of chlorine per hour. This safety feature prevents the car from emptying itself into the air in the event of a broken discharge pipe line or control valve.

The two valves in line across the car connect directly to the inside at the top of the chlorine tank. Only gas may be withdrawn from these valves. They are seldom used for discharging the contents of the car. The reason for this is to be found in the fact that as gas is withdrawn the continued evaporation from the liquid required to provide a continuous supply of gas reduces the temperature of the car contents to a point so low that the vapor pressure is insufficient to maintain a reasonable flow of gas. Since the car is insulated with



five inches of cork, there can be no significant replacement of this heat loss through the shell.

In spite of the excellent insulation, low winter temperatures will often reduce the temperature of the liquid and the vapor pressure in the car to a point low enough to reduce the flow of liquid to a marked degree. To avoid interruption of service, or slowing down of bleach making, and other operations requiring chlorine, additional air pressure may be imposed on the surface of the liquid and the flow from the car increased to a satisfactory rate. In some cases this additional air pressure is applied by the manufacturer of the chlorine at the time of loading the car during the cold winter season. In other cases, the user applies air pressure to the liquid through one of the gas valves, in the car dome (Figure 3).

◆ It is essential to provide adequate drying equipment to remove all the moisture from the air used in building up the tank car pressure. Sulphuric acid or fused calcium chloride is generally used as a drying agent. The convenience of calcium chloride makes it preferable for this service. A typical arrangement of compressor dryer and tank car connections is shown in Figure 4. It is desirable to locate the air dryer close to the compressor and indoors, so as to avoid the possible condensation of moisture from the transported air in sections of the line that are exposed to very low outdoor temperatures. It is also necessary to equip the air line with a pressure reducing valve that will prevent the tank car pressure from rising above 225 pounds per square inch. The safety valve and frangible disc on the tank car are set to release at this pressure. Since it is seldom necessary to have a tank car pressure above 150 pounds per square inch for satisfactory operation, it is advisable to set the air line reducing valve at this figure on the tank car side.

Valves used for chlorine control on large lines should be of all iron extra heavy construction. Yoke type ammonia valves are suitable for the purpose. Certain special valves are constructed for use with chlorine which have stems, seats and seat rings of particularly resistant alloys.

Much trouble has been experienced in the past in maintaining chlorine control valves next to the point of chlorination, either in the direct chlorination of pulp or milk-of-lime. As the pipe line extending from these valves usually enters a water suspension of pulp or lime, the solubility of the chlorine in these aqueous liquids will cause them to be drawn back to the control valve when the chlorine flow is stopped, unless the line is vented after being shut off. Hand operated auxiliary vent valves have been used for this purpose, but they leave much to be desired from the chemical as well as human angle. An automatic vacuum break valve has been designed and is now in use in a number of mills, venting the discharge side of the chlorinating line when the rise of liquid in the line threatens to reach the control valve. The control valve is thus protected from extreme corrosion and, naturally, gives longer and better service. The methods of installing the vacuum break and its relation to the control valve is shown in Figures 5, 6 and 7.

In pulp bleaching operations using chlorination in the first stage, definite quantities of chlorine are measured into known weights of pulp in water suspension. In some plants it is convenient to carry out this chlorination in a Bellmer, Hollander or beater. As such equipment is relatively shallow, it is impossible to use chlorine directly as the depth is not sufficient to permit the gas to dissolve in the pulp suspension before reaching the surface. This is true even where diffusers are used to aid the distribution of the gas from the bottom of the equipment. To cover such conditions, the ejector is used to prepare a water solution of chlorine which is allowed to run into the pulp suspension. The density of the pulp may be that commonly used in such equipment which is seldom lower than 3½ per cent or much higher than 7 per cent. Introduced at a concentration of 1 per cent or more, the chlorine water solution causes some dilution of the stock during the chlorination operation, but the reduction in pulp consistency need not be greater than 4 per cent of the original consistency. Such small reduction is relatively insignificant (See Figure 8).

Numerous studies have been made on the chemistry of pulp bleaching. The constant stream of processes patented in this country and abroad, however, is evidence of the fact that our present knowledge is empirical and has more practical than theoretical background.

Certain facts have been established that serve as guideposts for the application of the usual treatment and a majority of the variations to be found in the patent literature.

While other materials are used to some extent in commercial pulp bleaching, it may be said that practically all processes depend upon the use of chlorine,

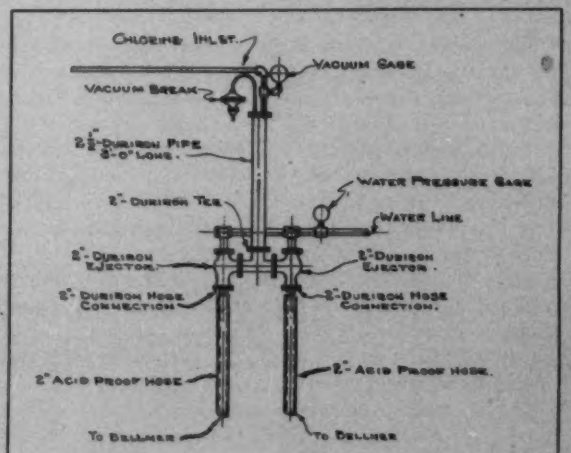


FIGURE 8

calcium hypochlorite and alkalis applied in one or another prescribed order and manner.

In order to use chlorine as gas for direct chlorination of pulp, at a rate which permits efficient operation, it becomes necessary to provide means for vaporizing the liquid as required. The heat of vaporization of liquid chlorine is 67.38 calories. To vaporize 100 pounds of liquid chlorine, 9700 B.t.u.'s are required. In terms of steam, this is equivalent to 12 pounds, or as electric

power, 2.84 kw.-hr. Hot water is the usual medium used in applying heat to vaporizers. Both electric power and steam are used as original heat sources, although the latter is most common.

Heat for vaporizing is most safely and conveniently applied by means of a water bath. The flow of steam for heating the water bath should be controlled by a thermostat. The use of water as a heating medium provides a measure of safety since it cannot be heated beyond its boiling point. Therefore, the vaporizer cannot be heated to a temperature that will permit serious reaction of the chlorine with the metal of the vaporizer. Direct application of dry heat as from electric resistance coils could easily create a hazard by bringing the vaporizer temperature to this point. The result would be the rapid destruction of the vaporizer and possibly a serious chlorine leak.

A practical type of vaporizer is shown in Figure 9. This is connected into the liquid chlorine line at (a). As chlorine enters, it vaporizes creating a vapor pressure equal to the liquid chlorine line pressure. As chlorine gas is drawn from (b) to the point of application, the vapor pressure drops correspondingly and additional liquid runs in to maintain the pressure equilibrium and a continual supply of chlorine gas.

In batch operations it is quite common to weigh the chlorine used in first-stage chlorination. This is done by floating a ton container on the chlorine line with the container resting on suitable weighing scales. The ton container is alternately filled to the desired point and emptied through a vaporizer to the pulp chlorinator. It will be recognized that where single unit cars are used the car pressure on the line must be held at a point above the vapor pressure of the chlorine in the weighing container in order to operate in this manner.

◆ There are now in use three general methods of making calcium hypochlorite solutions for pulp bleaching. This statement does not take into consideration the dissolving of bleaching powder which has become of distinctly minor importance in pulp bleaching practice. All of the larger mills, and most of the smaller ones, bleaching their own pulp, dissolve chlorine in milk-of-lime by one of the three methods which have become more or less standard for this operation.

Since the materials, general conditions and finished product, are the same for each method they cannot properly be called different processes. Rather, they are variations of the same process; the variations being only in the detail of equipment design and operation.

The chemical reactions involved in making calcium hypochlorite solutions are of the simplest nature and may be satisfactorily represented by the following—

$$2Ca(OH)_2 + 2Cl_2 = Ca(OCl)_2 + CaCl_2 + 2H_2O$$

It will be recognized that this is not an exact representation of the chemistry of the reaction, since it could be assumed from the reaction shown that dry hydrated lime and dry chlorine brought together under suitable conditions would form calcium hypochlorite. Such is not the case, however, as the end product of such a reaction is a calcium oxy-chloride containing hydrated lime as a part of its composition. Ditz gives the formula of this type of compound as $CaO.CaCl(OCl).H_2O$. Moisture in excess of that required to insure the complete hydration of the lime must be present to permit satisfactory reaction. The finished product is bleaching powder; not calcium hypochlorite.

An examination of Ditz's formula will indicate some explanation of the behavior of bleaching powder in the preparation of its solutions. Containing, as it does, hydrated lime as a part of its composition, it is not only slowly soluble but the immediate solubility is limited to that of the lime contained. Since the solubility of lime as $Ca(OH)_2$ in such solutions is approximately 1.9 grams per liter, the compound must be broken down by the water with a continual precipitation of lime. This accounts in part for the long period of agitation required to form proper solutions from bleaching powder. It will be seen readily that once a solution is formed the excess lime is available for further chlorination; in fact, this is the basis of method for making bleach liquor practiced for a short time in this country when liquid chlorine was first introduced and still practiced abroad to some extent.

◆ When hydrated lime is suspended in water, it naturally dissolves to the limit of its solubility. Any reaction which removes it from solution makes it possible for a further part of the suspended material to dissolve. This is what happens when chlorine reacts with the dissolved lime. The calcium hypochlorite and calcium chlorides formed actually increase the solubility of the remaining suspended lime and permits the reaction to proceed until all the lime has dissolved and reacted.

In actual practice the reaction is never allowed to convert all the lime, as a slight excess alkalinity is desirable to prevent possible decomposition of the hypochlorite in the finished solution. Under any existing mill conditions it would be impossible to balance the quantities of chlorine and lime required to satisfy the reaction exactly. The slightest excess of chlorine will cause the hypochlorite to decompose as follows—

$$Ca(OCl)_2 = CaCl_2 + O_2$$

An excess of dissolved lime avoids over-chlorination but also provides protection against decomposition which might be caused by absorption of carbon dioxide from the air.

Commercial hydrated lime seldom exceeds 92 per cent $Ca(OH)_2$ content. The remainder includes such insolubles as silicia, alumina, calcium carbonate and complex compounds, either originally present in the limestone or formed during the burning or dissolving operations. Commercial chlorine is better than 99.8 per cent pure. Therefore, 100 pounds of chlorine will require approximately 104 pounds of actual $Ca(OH)_2$ for complete reaction. At 88 per cent purity, 118.5 pounds of lime would be required for 100 pounds of chlorine. In actual practice the charge of lime is generally calculated on the basis of 120 pounds for each 100 pounds of chlorine. If the lime is low in $Ca(OH)_2$ content the lime-chlorine ratio will have to be increased correspondingly.

There is another point which should be given consideration in choosing a lime for calcium hypochlorite production. Chlorination is seldom carried to the point permitting the last few pounds of lime to actually dissolve. This undissolved lime and the suspended insolubles must be settled from the solution before it may

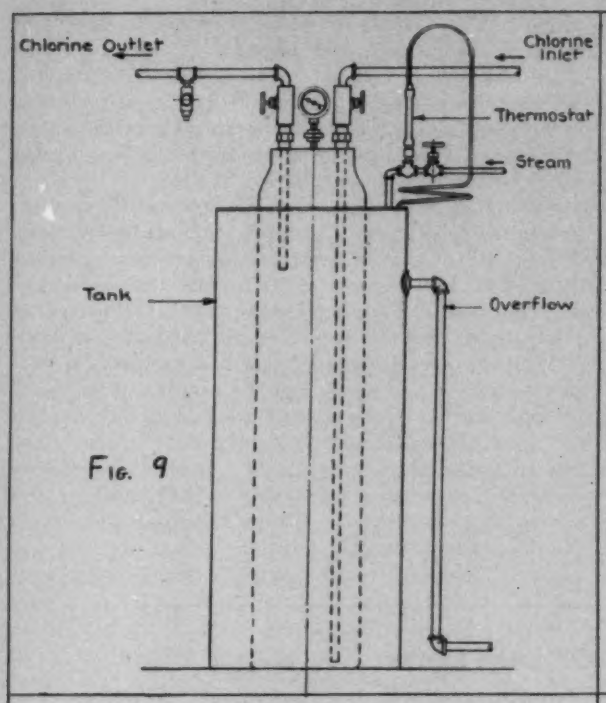


FIG. 9

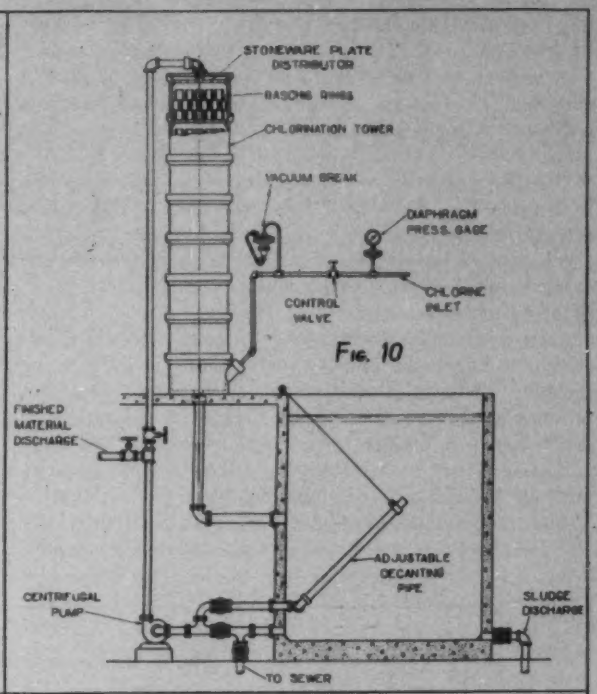


FIG. 10

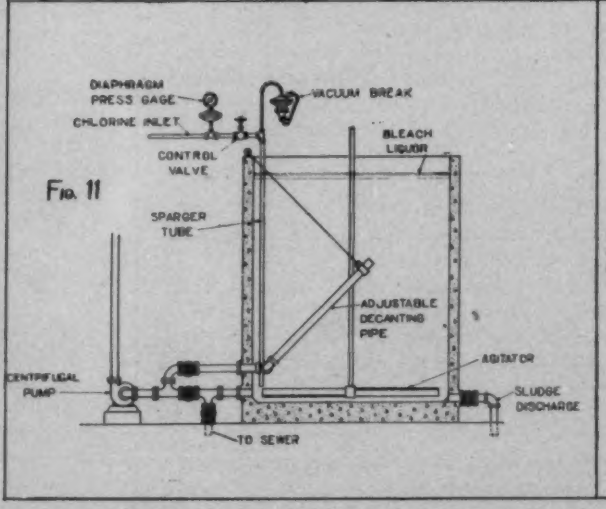


FIG. 11

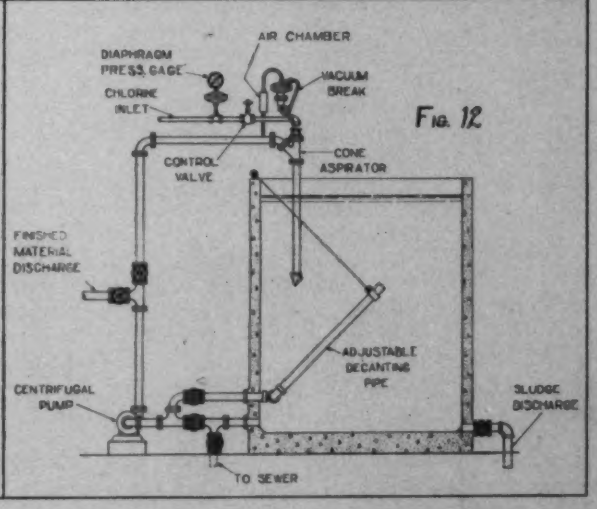


FIG. 12

be satisfactorily used in bleaching pulp. The properties of the lime used will determine the rate of settling of these undissolved materials. The rate of settling will, in turn, measure to some extent the number of batches of bleach liquor which may be made up in a given period with given equipment. When equipment is operated at or near its capacity limit, rapid settling is of first importance.

One of the first methods used for producing calcium hypochlorite for bleach liquor was that of the tower and tank arrangement as shown in Figure 10.

In this equipment the milk-of-lime made up at a concentration of approximately 36 grams per liter is circulated by means of the pump to the top of the tower and in passing down over the packing absorbs chlorine which is admitted at the bottom. The finished solution contains approximately 20 grams available chlorine per liter.

The size of the tank is generally such as to accommodate sufficient milk-of-lime to absorb one ton or more of chlorine. At 30 grams per liter the tank capacity would be 8500 gallons or more.

The tower is of stoneware and is filled with acid resisting packing. The tank is generally of concrete construction. Iron pump, piping and valves are often used although in some instances acid resistant alloys are applied to this service.

The tower and tank system works satisfactorily and produces a good grade of bleach liquor. It is necessarily cumbersome since it has been found that the tower is not required for good absorption of chlorine.

A second system is illustrated in Figure 11. This represents the direct absorption of chlorine delivered as liquid to the bottom of a tank containing the milk-of-lime. The delivery pipe in the tank is sometimes called the sparger tube. A solution containing 30 grams

per liter available chlorine may be prepared in 45 minutes to one hour. In this type of equipment it is necessary to have a tank depth at least 10 feet to permit complete absorption of the chlorine before the gas bubbles reach the surface.

◆ The third type of bleach make-up equipment is shown in Figure 12. This consists of the milk-of-lime tank, circulating pump and ejector in the delivery line from the pump. It is not essential to have an agitator in the tank since the pump provides adequate agitation in circulation of the milk-of-lime. The tank may be round, square or of any other practical shape. It is not limited as to height as the absorption occurs largely in the ejector. If an agitator is not used the floor of the tank is made with a gentle slope to the outlet delivering to the pump. A definite advantage of this design rests in the fact that the ejector establishes a negative pressure on the chlorine line and not only aids in the delivery of chlorine from the container but will withdraw the gas to a point where its pressure is less than atmospheric. This naturally means a more efficient and complete emptying of containers.

In plants that consume considerable quantities of chlorine for making bleach liquor, it is often necessary to have duplicate equipment and tanks for bleach liquor storage and arrangements for washing the lime sludge which accumulates over a period of time.

Altogether the handling of chlorine and its application to the production of bleach liquors may be resolved into relatively simple elements. As in other chemical operations, the problem is essentially one of understanding and giving consideration to the properties of the reagents and the nature of the reactions involved.

Although specialized equipment is required to care for specific conditions at some points, it is possible to utilize standard construction materials and accessories for the major parts of satisfactory installations. The use of technical facts well lubricated with common sense, will serve as a safe guide to both engineer and chemist responsible for chlorine handling and bleach plant construction and operation.

How to Handle Chlorine Leaks

◆ Persons handling chlorine should be protected from leaky containers. For this purpose, the Bureau of Explosives recommends that at each unloading station there be provided at least one chlorine gas mask, with a canister attachable to the back of the user, of a design approved by the United States Bureau of Mines. That Bureau also recommends that at least one employee at each unloading station be instructed in the use of such masks and also instructed as follows:

◆ Keep on the windward side of the leak.

◆ If leakage is extensive, promptly warn all persons in the path of the fumes to move to a safer location, preferably to an elevation considerably above unloading location.

◆ Use hose to spray water freely under slight pressure on the escaping liquid. This forms chlorine hydrate, from which the evaporation of gas is slow. Caustic soda dissolved in water adds to its effectiveness as an absorbent of chlorine gas.

◆ If tank is punctured above the liquid, the gas will escape, and as water applied to gas leakage is not effective, the tank should be turned over to bring point of leakage below the level of the liquid. Leakage of liquid can then be retarded by the use of water.

◆ If water is not immediately available, dig a trench to draw off the liquid to a lower spot, the object being to reduce the area of the surface of liquid from which evaporation takes place. Loose earth; cement; lime, either fresh or slaked; and textiles, wet or dry, especially bagging and felt, thrown on the liquid at once will act as an absorbent or blanket and effectively retard evaporation. If available, dry ice (solid carbon dioxide) packed as well as possible around the leaking container will so reduce the pressure that the leak will be greatly reduced.

◆ When attempting to plug a leak in any manner, hands and body should be protected against the escaping chlorine by the use of thick, loose-fitting gloves and a long apron of leather or similar flexible, non-porous material.

◆ In a severe fire, leakage should not be serious as the gas will be carried upward and dissipated with the products of combustion. If the container is not leaking, every effort should be made to extinguish the fire.

◆ When a pond or larger body of water is available nearby, the leaking tank should be entirely submerged, otherwise, if possible, tank should be moved to a point where escaping vapor will be carried by the wind away from the railroad yard or right-of-way and adjacent occupied buildings.

(For further information regarding the handling of chlorine, address National Safety Council, 20 North Wacker Drive, Chicago.)

The Bleaching of *Western Hemlock Sulphite*

N. W. COSTER, Technical Director
Soundview Pulp Company

◆ THE MANUFACTURE of bleached sulphite pulp in the Pacific Northwest, particularly in the State of Washington, has increased tremendously during the last decade. Whereas ten years ago practically no bleached sulphite pulp was manufactured in this region to be sold on the open market, today there are five modern mills having a total annual output of approximately one quarter of a million tons. Furthermore, this tonnage has obtained worldwide recognition as a superior product not only as a raw material for the paper industry but also for the Rayon and Cellophane and allied industries.

One of the reasons this Pacific Northwest product has been able to establish itself firmly on the world market is that when designing and constructing these mills only the latest methods and equipment were used. Hereby it has been possible to purify the cellulose to the fullest extent without causing any damage to the physical and chemical properties of the same.

The principal raw material for this industry is Western hemlock of which there is an abundant supply. It has been estimated by the United States Forest Service that in western Washington alone, between the summit of the Cascade Mountain Range and the Pacific Ocean, there are at present over eighteen billion cubic feet of this species suitable for pulpwood.

It has been proven beyond a doubt that the Western hemlock is an excellent raw material for the pulp industry and is fully as suitable as the spruce growing on the Eastern North American Continent and in Europe. The fiber length and cellulose content of Western hemlock exceed considerably the ones of the above mentioned spruce species and besides these qualities the resin content of Western hemlock is very low, being only about one half of the one in spruce. This is a particularly important feature as it does away with all pitch troubles so often occurring when using spruce sulphite pulp in the manufacture of not only paper but also of Rayon, Cellophane, etc.

However, the Western hemlock contains certain very colored residues, especially in the ray cells of the heartwood, these coloring materials resembling in chemical behavior the coloring matter extracted from Western hemlock bark and is, therefore, probably a tannin or tannin derivate. It is only through very careful bleaching in two or more stages that it is possible to remove this coloring matter and at the same time produce a pulp of superior whiteness and strength.

The three most important factors in bleaching are: time, consistency and temperature; all three being very intimately related, and both quality and economy of operation being determined by the balance between these factors.

If the bleaching is done at low temperature and low consistency a product of satisfactory whiteness and strength can be obtained, but such an operation would take a very long time, and, besides involving a prohibitive amount of space and equipment, would give a very dirty product. The time element can be shortened by increasing the temperature, but by doing so the danger of over-oxidation followed by weakening of the fiber strength occurs, and the amount of steam necessary to raise the temperature is costly.

However, by using high consistency and low temperature the time factor is reduced even more than at the high temperature low consistency procedure, and by using the correct mixing apparatus all danger of over-oxidation is avoided. Besides this, the product obtained is much cleaner than the one from the low consistency procedure on account of perfect penetration of the bleach liquor into the shives and fibers.

As the bleaching proceeds, the amount of reaction compounds is increased, the presence of which is detrimental in more than one way as their accumulation not only retards the bleaching reaction but also reacts with more chlorine than is necessary for their removal. It is necessary, therefore, to carry an excess of bleach-liquor to keep these compounds from precipitating on and discoloring the already bleached fibers.

◆ If a curve showing the chlorine exhaustion rate for a single-stage bleaching process is examined, it will be noticed that during the first period of the bleaching, the exhaustion is very rapid, but after a while it slows down considerably. This decrease is accounted for by the accumulation of reaction compounds. Consequently, if the bleaching is discontinued at the point where the exhaustion curve flattens out, and this is called the first stage, it can be seen readily how rapidly this first-stage bleaching can be done. After the bleaching products have been washed out, the remaining impurities can be removed easily in a second stage with fresh bleaching reagent and washed out giving a fully bleached product with minimum consumption of bleaching reagent.

The two-stage bleaching, therefore, can be considered to accomplish the following:

(1) In the first stage, the majority of impurities are brought in solution and washed out.

(2) In the second stage, the small amount of remaining impurities are bleached out through an oxidation to a colorless material and washed out. As the amount of impurities is very small in this stage, not enough of them are present to retard the bleaching process and consequently the same can be performed with small amounts of chlorine at low temperature and reasonable time, especially if it is conducted at high consistency.

In the early stage of the bleaching process where the reaction speed is very great, it is of utmost importance

that the mixing of the pulp with the bleaching reagent is rapid and thorough. This can be best obtained by using low consistency. Another advantage of using this system is that it makes high density thickeners unnecessary.

The proportion of chlorine used in the various stages is very important when it comes to not only chlorine economy but also to the qualities of bleached pulp. When bleaching Western hemlock sulphite pulp by a two-stage operation, it has been found necessary to use at least 75 per cent of the total amount of chlorine required in the first stage in order to bleach out the previously mentioned coloring matter of tannin nature in the second stage without injuring the cellulose and at the same time obtain a high color.

Many articles have been written concerning the proportion of chlorine that should be used in the different stages in order to obtain highest possible chlorine economy. However, it is the author's opinion that in these days of strong competition and steadily increasing demand for higher quality, the matter of chlorine economy is of secondary order.

When using such great amounts of bleaching reagents, as 75 per cent of the total amount required, in the first stage, it has been found advantageous to use chlorine gas, either alone or in conjunction with hypochlorite, instead of straight hypochlorite solution. This is done not only to improve the chlorine further and to shorten the bleaching time, but also in order to obtain a higher yield as compared with hypochlorite bleaching. This increase in yield mostly is due to the fact that when dealing with gaseous chlorine in one way or another the removing of impurities is done through chlorination of the lignin instead of through oxidation as when using hypochlorite solutions. When using chlorine gas in such great quantities as mentioned above it is generally considered advantageous to neutralize the formed hydrochloric acid with a suitable alkali in order to protect bleaching and washing equipment from the strong corrosive action of the hydrochloric acid and also to bring into solution some of the chlorination products that are not soluble in the presence of this acid concentration. When using a combination of chlorine gas and hypochlorite solution this neutralizing is not necessary because by maintaining the correct relation between chlorine gas and alkaline hypochlorite solution the acidity can be kept at such a low concentration that the above mentioned effects of presence of hydrochloric acid are negligible.

◆ There are several different methods in use by which the chlorine is introduced in the pulp. One method is by letting the chlorine gas come in contact with the pulp at the point in the bleacher where the agitation is most violent, in other words, as close to the agitating propeller as possible. This method uses a pulp consistency of approximately 3 per cent.

Another method is by introducing the chlorine gas at the discharge side of the pump which forces the pulp through a tower, the latter being of such dimensions that the chlorine is exhausted when the pulp reaches the top of same. This method also uses a pulp consistency of approximately 3 per cent and is mostly used for continuous chlorination.

A third method mixes chlorine and water in an injector, there forming an emulsion of chlorine and water, the same being more readily absorbed by the pulp than the chlorine gas in its natural state. With this method of applying chlorine gas, it is possible to use as high consistency as 6 per cent.

In each of these three methods, the chlorination is done at low temperature and in no case does the same exceed 70 deg. Fahr. It is quite evident that tremendous advantages are gained by a multi-stage bleaching using chlorination in at least one stage. As all the previously mentioned mills employ this system in one way or another, a more detailed description might be of interest.

◆ Some mills, having a two-stage bleaching system, use a combination of chlorine gas and hypochlorite in the first stage at a pulp consistency of 4 per cent. The amount of bleaching reagent used in this stage is 80 to 85 per cent of the total amount required and the bleaching is done at a temperature of 70 deg. Fahr. After washing and thickening the final bleaching is done with alkaline calcium hypochlorite solution having an available chlorine concentration of 15 grams per liter. The bleaching is done at a pulp consistency of approximately 15 per cent and at a temperature of 80 deg. Fahr.

Other mills use a three-stage bleaching process whereby the bleaching in the first stage is done with chlorine gas at approximately 3 per cent consistency and in the cold. The chlorination is followed by a neutralizing with milk-of-lime. After washing and thickening the bleaching in the second stage is done at approximately 15 per cent pulp consistency and a temperature of 80 deg. Fahr. with alkaline calcium hypochlorite solution having an available chlorine concentration of 15 grams per liter. After washing, the final and third-stage bleaching is done at approximately 3 per cent consistency using chlorine gas. The amounts of bleaching reagent used in the different stages are about 75, 24 and 1 per cent respectively, of the total amount required.

Some other mills employ a three-stage bleaching system wherein the first stage bleaching is done by continuous chlorination in a tower at approximately 3 per cent consistency and in the cold. After washing and thickening, the second-stage bleaching is done at about 15 per cent consistency and with alkaline calcium hypochlorite solutions. The pulp is washed again and thickened and the final bleaching done under conditions similar to the second stage. The ratio of chlorine in the different stages generally is 40, 50 and 10 per cent of the total amount required.

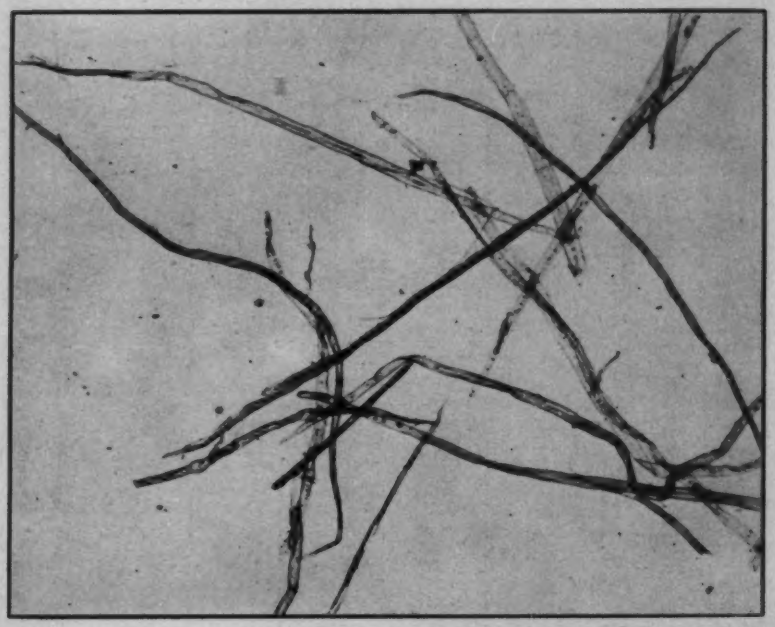
In each of the methods described above, the final bleaching is, of course, followed by washing, and the washing systems employed are so efficient that even with the fiber-loss held to a minimum these pulps are noted for their low ash content.

Through these methods of bleaching, it is possible to manufacture a pulp of excellent strength and color, using less than 100 lb. of chlorine per ton of pulp. As all bleaching is done at low temperatures, the cost of steam for heating is very low; the steam consumption is generally only a few hundred pounds per ton of pulp.

Another feature of these bleaching procedures is that through absence of overbleaching and subsequent over-oxidation of the cellulose, the shrinkage is low and for pulps of extreme whiteness never exceeds 8 per cent.

By automatic control of the consistency in the different stages, the operators in these mills are able to fill all bleachers with the same amount of pulp. The exact amount of chlorine needed for bleaching these quantities of pulp in the different stages is found by using correct and suitable methods for bleachability determinations. These amounts of chlorine are either weighed or measured out for each and every individual operation, thereby assuring that nothing but the correct amount is added. The heating of the pulp, when necessary, generally is done by the use of hot water giving an even distribution of heat through the pulp mass and preventing local overheating. The temperature of this water is very often maintained at desired point by the use of thermostatic control.

Although it is impossible in the bleach plant to remedy any damage already done to the cellulose during earlier stages of manufacture, bleaching procedures, like those which have been described, enable the operators to manufacture a product of excellent whiteness and strength without any damage being done to the cellulose structure. It is even a fact that under certain conditions at least some of the strength properties have been improved. That the chemical properties of these pulps have not been destroyed can be seen easily from their high alpha cellulose content and low copper number. And last, but not least, when it comes to cleanliness, these bleached sulphite pulps, manufactured on the Pacific Coast, have a world-wide reputation for their extreme cleanliness.



Unbleached Western hemlock sulphite X-65

Courtesy U. S. Forest Products Laboratory

Bleached Western hemlock sulphite X-65

Hardwood Sulphite Bleaching

W. M. OSBORNE

◆ THE FIRST commercial manufacture of hardwood sulphite pulp was at the Newton Falls Paper Company, Newton Falls, New York. The kinds of wood utilized were: maple, birch and some beech. The resulting pulp was fully bleached, as the unbleached pulp was not satisfactory for the grades of paper made at the plant.

Hardwood sulphite in the unbleached state is somewhat specky, but bleaches out. The fibers are short and are not suited to the manufacture of strong, tough papers. Where a well closed sheet or a smooth finish is desirable, the fibers are very adaptable. Bleaching renders the fibers somewhat transparent.

The bleaching of pulp is effected by certain basic relations which govern the bleach requirement and the quality of the final bleached product.

Assuming the chips are clean and uniform, the next important step is the acid and digestion process. In general, the cooking liquor should be of a high, free

TABLE 1

Low combined SO_2

Hour	Temp. Fahr.	Gauge Pressure	Per cent SO_2		
			Total	Free	Comb'd
0	...	..	5.60	4.61	0.99
1	132	12	...	...	...
2	162	22	2.14	1.69	0.55
3	212	48	1.80	1.36	0.44
4	233	64	1.30	1.02	0.28
5½	252	72	0.55	0.80	...
6	260	72	0.32	...	...
7	266	72	0.24	...	...
8	270	70	0.12	...	...

and combined SO_2. It is of greater importance to have a high combined SO_2 in the cooking of hardwood than in the cooking of softwood.

Tables 1, 2 and 3 show the various acids used, together with cooking data. These tables indicate the need of the proper acid to suit the wood being digested. When the proper cooking curve is outlined and the combined SO_2 regulated to suit the wood, the free SO_2 will adjust itself and the digester can be controlled to finish in the time available.

Tables 4 and 5 offer a study of the variables in the processing of hardwood. Cooks with the higher combined SO_2 had a better color and contained less specks. Under the same conditions of cooking, the higher combined SO_2 gave stronger pulp and had less loss in bleaching.

Many pulp mills prepare their pulp for the bleaching stage. This preparation covers a lot of ground, the use of caustic soda of varying amounts and concentrations being used. In some cases, the caustic is used before the pulp reaches the bleach cells where the solvent and neutralized products are released from the fibers by washing. Others add the alkali to the cell during the filling or course of bleaching. The effect is somewhat different when the alkali is added to the bleach-cell. Where the bleaching is carried out in two stages of hypochlorite, the greater percentage usually is added

TABLE 2

Normal combined SO_2

Hour	Temp. Fahr.	Gauge Pressure	Per cent SO_2		
			Total	Free	Comb'd
0	...	..	5.95	4.77	1.18
1	140	10	...	...	...
2	198	42	...	...	...
3	210	64	...	...	0.74
4	232	70	...	...	0.45
5	248	74	...	...	0.30
6	260	72	...	...	0.18
7	278	72	...	...	0.08
8	292	74	...	...	0.04
9	300	70	...	...	0.01
10	300	70	...	...	...

TABLE 3

High combined SO_2

Hour	Temp. Fahr.	Gauge Pressure	Per cent SO_2		
			Total	Free	Comb'd
0	...	..	5.63	3.90	1.77
1	162	..	...	...	...
2	190	..	...	...	...
3	230	68	...	...	0.85
4	244	68	...	...	0.60
5	252	68	...	...	0.48
6	262	68	...	...	0.40
7	265	68	...	...	0.28
8	272	68	...	...	0.18
9	272	70	...	...	0.08
10	280	68	...	...	0.06

TABLE 4

Cooking Data

Cook No.	Acid test		Temp. Fahr.		Digester Pressure	Pressure at blow	Hours Cooking
	Total	Combined	At Pressure	Maximum			
1	4.29	1.52	221	306	70	11	10
2	4.32	1.28	248	310	70	7	9.5
3	4.36	1.24	233	304	70	13	10.25
4	4.25	1.04	187	310	70	7	12
5	4.15	1.23	238	312	70	7	10
6	4.16	1.22	244	304	70	13	10.25
7	3.94	1.37	242	310	70	7	9.5
8	3.84	1.47	254	312	70	4	9.25
9	3.80	1.54	243	308	70	9	10
10	3.83	1.48	234	312	71	5	9.5
11	4.03	1.09	246	300	70	17	9.5
12	3.97	1.15	254	308	70	9	10
13	4.00	1.18	257	311	70	6	9.25
14	4.48	1.15	232	310	70	7	10.25
15	4.29	1.09	258	312	70	7	10

TABLE 5

Bleaching Data

Cook No.	G.P.L. Bleach	Per cent Consist.		Strength		Freeness		Max. Temp.	Per cent Bleach
		Before	After	Before	After	Before	After		
1	28.3	29.5	20.6	0.60	0.68	6.14	3.81	100	17.8
2	29.5	28.9	22.5	0.67	0.61	5.22	6.01	96	18.1
3	27.1	29.2	22.6	0.75	0.71	7.06	5.54	97	19.8
4	27.1	29.2	23.1	0.72	0.70	7.06	5.48	92	16.7
5	26.3	29.2	22.3	0.67	0.70	4.53	5.57	95	16.0
6	27.5	26.9	21.8	0.65	0.67	6.87	4.54	100	19.0
7	28.0	31.5	21.2	0.69	0.68	4.17	9.68	98	16.8
8	27.0	29.4	19.4	0.70	0.69	4.30	5.66	94	17.0
9	27.0	27.1	18.5	0.71	0.68	5.08	6.35	100	17.3
10	28.1	26.3	20.1	0.70	0.66	5.45	4.02	100	16.6
11	27.1	26.1	19.3	0.70	0.68	4.84	4.68	100	18.1
12	26.3	28.5	20.3	0.69	0.58	4.51	3.48	92	17.6
13	26.3	26.4	16.9	0.54	0.61	5.33	4.10	96	20.8
14	26.3	27.6	17.7	0.59	0.57	2.96	3.37	98	20.4
15	26.3	27.6	17.9	0.60	0.57	2.96	3.39	93	17.3

TABLE 6

Two-stage (treated)

	First Stage	Second Stage
Max. Temp.	78	98
G. P. L. liq.	31.16	31.16
Gals. liq.	1170	495
Pounds bleach.	868	367
Per cent bleach.	8.343	3.57
Alkali	.....	6.0 lb. (per ton)

Total bleach used—11.91 per cent (35 per cent powder)

TABLE 7

Physical Properties

Alpha Cellulose 92.3 per cent (fully bleached)

Ashcroft Strength Ratio

Minutes Ball Mill	Unbld.	First Stage	Second Stage
15	.26	.40	.46
25	.47	.50	.48
35	.48	.51	.43
45	.37	.54	.42
55	..	.51	..

Per cent Freeness

Minutes Ball Mill	Unbld.	First Stage	Second Stage
15	3.5	3.3	3.2
25	3.1	3.3	2.9
35	3.1	2.9	2.8
45	2.6	2.9	2.4
55	..	2.4	..

in the first stage, and is consumed rapidly. There would be no benefit from the use of alkali in this stage. The remaining percentage of bleach used in the second stage should be treated with an alkali.

The fibers are reaching a greater state of purity as the bleaching proceeds, therefore, the bleaching agent should be alkline to protect the fibers from rapid bleaching at the outer wall or surface of the fiber. Since the bleaching progresses with the degree of pH at a given temperature, the amount of alkali can be calculated for a given chlorine demand.

The use of alkali on hardwood was found to reduce the bleach requirement and to result in a better pulp. Reduction of over 17 per cent in the bleach has been noted by the alkali treatment.[1]

Pre-chlorination also can be classed as a pre-treatment since it dissolves the undesirable constituents of the fiber by chemical reaction rather than oxidation. This phase of pre-treatment has been covered by several investigators.[2] The use of pre-chlorination of hardwood is highly desirable and adaptable.

The bleaching of hardwood sulphite is best carried out in two or more stages with a wash between the stages. Savings of 40 per cent are made by this type of bleaching.[3]

The rate of bleaching action is very rapid with hardwood and the alkalinity carried in normal bleach liquor is not sufficient to maintain the proper degree of pH during bleaching. This is corrected by the addition of alkali. It has been noted that the use of lime worked just as well as other alkalies for this purpose—the pulp having received an alkaline treatment before reaching the bleach cell and the dissolved products removed by washing. Any increase in the bleaching time due to the addition of alkali in the second or final stage is well spent as the saving in chlorine is considerable and the product is better.

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(2) J. D. Rue, Sconce, Niagara Falls, N. Y.
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Bleaching Soda Fiber

E. SUTERMEISTER, Chief Chemist
S. D. Warren Company

◆ ANYONE who attempts to study the bleaching of soda pulp in any detail immediately finds that by far the greater part of the experimental work and published data on bleaching applies to sulphite fibers, with sulphate fiber second and soda pulp a poor third. This is doubtless due to the facts that sulphite and sulphate are strength giving constituents in paper and that they greatly exceed soda fiber in amount produced. Any effect which bleaching may have on strength is, therefore, of much less importance in the case of soda fibers, at least those made from poplar and other short fibered woods. Whatever the reason, the fact makes it difficult to discuss the bleaching of soda fiber without encroaching on the field of sulphite bleaching and without assuming that facts which have been proved for sulphite apply equally well to soda.

With soda pulp, as well as with pulps cooked by other methods, the kind of wood used and the cooking conditions have a great influence on the amount of bleach required to give a standard color and on the chemical and physical properties of the resulting product. A little idea of the influence exerted by the kind of wood may be obtained from the following figures which have been compiled from Bulletin 1485 of the U. S. Dept. of Agriculture.

Bleach required by fiber on oven dry basis	When wood is cooked to a yield of	Kinds of Wood
10-15	45-50	Aspen, beech
10-15	35-40	Chestnut
15-20	45-50	Balsam poplar, cottonwood, black willow, sycamore
15-20	40-45	Large tooth aspen, yellow poplar, red maple, yellow birch
15-20	35-40	Red gum, paper birch
20-25	45-50	Basswood
20-25	40-45	Red alder
20-30	45-50	Cucumber magnolia
20-30	35-40	Black gum
25-30	40-45	Sugar maple
25-30	35-40	Tupelo gum

These figures are based on single-stage bleaching with the bleach all added at once. While the figures seem high in most cases, there is no means of knowing the standard of whiteness to which they were bleached. Since the tests were made under the same conditions, they are comparable and so show the effect of the kind of wood, except as they may be affected by the cooking conditions under which the fiber was produced. It is to be noted that this table includes no coniferous woods. Some of these occasionally are cooked by the soda process, but as a rule the fiber bleaches with so much greater difficulty than the short fibered pulps from hardwoods that they almost are never used for white papers.

The cooking conditions to which the wood is subjected also influence the bleachability of the pulp, though probably not to nearly as great an extent as in the case of sulphite. If the wood is undercooked and the fiber raw or shivey it naturally will require a larger amount of bleach than thoroughly cooked pulp. In the case of poplar pulp, the bleach required drops very sharply from the undercooked pulp to those normally cooked and then changes relatively little as the wood is more and more overcooked. In small scale cooks, it has been noticed that the bleach required may rise slightly as the yield drops, due to continuing the cook too long. This may be due to using up too much of the caustic soda in the cooking liquor, with resulting re-deposit of coloring matter on the fiber.

The washing of the pulp is another very important point in regard to bleaching. The coloring matter in the black liquor is able to use up large amounts of bleach, and for economical bleaching, it is essential that it be washed out as completely as possible. In examining one sample of black liquor of the strength blown from the digester with the pulp, it was found that each gallon used up enough bleach to bring about 45 pounds of fiber to a good commercial color. As about 15,000 gallons of black liquor were present in this cook and the yield was 18,000 pounds it is easily calculated that each tenth of one per cent of the original black liquor remaining with the pulp uses up enough bleach to bring 3.7 per cent of the fiber to a commercial color.

The passage of the stock through the knotters and screens has little effect on the bleaching operation except that it removes small quantities of shives and knots which would absorb some bleach.

The bleaching operation formerly was carried out in open tanks, furnished with agitators, at consistencies of 2½ to 3½ per cent, or in beaters or Bellmers at consistencies of 5½ to 7½ per cent. Within the last few years there has been a decided tendency to bleach at much higher consistencies, such as 12 to 18 per cent, and numerous types of equipment have been designed for this work. The chief advantages claimed are savings in steam, time and bleach and a greater reduction in the shives and dirt in the finished product. On the other side of the ledger, high density bleaching means a high power input in order to maintain adequate agitation, and a greater degradation of the fiber from chemical action.

◆ The saving in steam is quite obvious, since much less water has to be heated. For 100 pounds of fiber at 12 per cent consistency the water present amounts to 733 pounds, but at 3 per cent the same amount of fiber is present in 3,233 pounds, which means that the cost for steam is over four times as great. This steam saving is still further increased at high consistency because the rate of reaction is so much greater that bleaching may be carried out in less time at lower temperatures. For example, when bleaching a certain pulp at 95 deg. Fahr. it required 22 hours to exhaust the

bleach at 2 per cent consistency, 14 hours at 4 per cent, 7 hours at 8 per cent, but only about 4 hours at 12 per cent.

Whenever steam has to be used, it is best to add it to the pulp before the bleach in order to avoid excessive local action. This especially is important in the case of high density operation and also more difficult to accomplish because the bleach is frequently mixed with the fiber before it enters the bleacher proper. Often this is done in some form of shredder which gives a very thorough mixing of the fiber and bleach and thus saves much of the time which would be needed to produce a uniform mixture if the bleach were added to the fully charged bleacher. When the steam cannot be added prior to the bleach it should be added slowly and at the point of maximum agitation so that overheating may be minimized.

The temperature at which it is safe to bleach soda fiber is said to be not over 115 deg. Fahr. at moderate consistencies and somewhat lower at high densities. At 12 to 14 per cent consistency it is found very satisfactory to bleach at about 90 degrees and during the summer the temperature of the water used and the heating caused by agitation are usually sufficient to reach this temperature without the use of steam. If the temperature of the water supply rises much over 70 degrees it may even be difficult to hold the temperature in the bleachers down to 90 degrees.

Agitation in the high density bleachers has a certain amount of beating action on the pulp, as may be seen from the following figures. In this test the unbleached pulp was agitated at a consistency of 13.5 per cent.

	Burst	Tear
Original unbleached pulp.....	31.5	11.4
Same after ½ hour in bleacher..	32.5	12.8
" " 1 " " " ..	32.7	13.6
" " 1½ hours " " ..	33.8	14.6
" " 2 " " " ..	33.0	15.4
" " 2½ " " " ..	33.8	14.4

The effect of consistency during bleaching on the color of the fiber produced is not at all marked, but unfortunately what little difference there is in the wrong direction in the case of soda fiber, the color becoming slightly poorer as the consistency rises. This negatives the claim for saving of bleach by employing higher consistencies, at least under the conditions where the bleach is all added at once.

The saving in time, already mentioned as being caused by bleaching at higher densities, formerly was obtained partially by adding a little acid to the mixture of fiber and bleach. In all probability, this caused some injury to the fiber, though when bleaching at low consistency it may have done little harm. It probably would be more injurious at high consistencies and is not to be recommended for such work.

When bleaching at about 12 per cent density, it has been found that the reaction of the charge normally becomes slightly acid when about half through the operation, measured by time. It is also true that the degradation of the fibers, as measured by copper number, is greater during the acid period. If enough alkali is added to prevent the development of an acid reaction, this degradation is avoided to a considerable extent and a better color is said to be obtained, although the bleaching time is considerably increased.

◆ The present tendency in bleaching is toward a two-stage, or even a three-stage, process. The first stage is usually with hypochlorite, the amount used being from 60 to 80 per cent of the total. This is then followed by a wash, with or without the addition of alkali to the wash water, and then the final bleaching with hypochlorite takes place. There are various combinations of consistencies and bleach proportions possible in such systems and the time of bleaching in each stage depends on the combination employed. With sulphite pulp there is still a question as to whether it is best to bleach at low consistency first and follow by high, or vice versa, and there is no reason to suppose that similar doubts do not exist in the case of soda fiber.

When using a two-stage process there are advantages in using chlorine or hypochlorous acid in the first stage. Even with hypochlorites the consumption of bleach is very rapid, at first, as is shown by the fact that when bleaching at 11 per cent density soda fiber uses up 85 to 90 per cent of the total bleach required in the first half hour of a 2½ hour bleach. With chlorine or hypochlorous acid the action is more rapid than with hypochlorite as indicated by the accompanying table.

Besides the increased rate of reaction, the use of chlorine has other advantages which make its use desirable. Its action is one of chlorination, rather than oxidation, and the chlorinated products are partly soluble in water and still more so in the weak alkalies used in treating the fiber before the second stage. As a result, the bleached product is not only somewhat better in color, but it also is stronger and less degraded chemically, as shown by a higher alpha cellulose content and a lower copper number.

Suggestions, in the form of patents, are found in the literature, that bleaching may be hastened by the use of nickel, cobalt, copper or other metallic compounds

Time in hours to exhaust the equivalent of 4 per cent of bleach

Fiber from:	Poplar			Hardwood		
Bleach as:	Hypochlorite	Hypochlorous acid	Chlorine	Hypochlorite	Hypochlorous acid	Chlorine
Temp. 77 deg. Fahr.	6.6	1.05	0.67	2.6	1.30	1.00
" 86 " "	4.7	0.80	0.40	1.8	0.80	0.58
" 95 " "	2.0	0.55	0.33	0.8	0.75	0.30

as catalysts. These are said to reduce the time of bleaching very greatly but not to injure the fiber chemically. Very little definite information is presented and it is not clear whether the process is equally applicable to soda and sulphite bleaching.

In any two-stage process, it is necessary to wash the pulp between the stages if any saving of bleach is to be made, for if the products of bleaching in the first stage are not removed they continue to use up bleach in considerable amounts. This washing may be done with fresh water only, but better results are obtained if the partly bleached fiber is given a treatment with a weak alkaline solution before washing. This removes the chlorinated or oxidized products much more completely than water alone and the resulting fiber has a lower copper number. The saving in bleach by this type of operation depends to some extent on the fiber being bleached—it is greater for hard bleaching than for easy bleaching fibers. It is difficult to determine accurately on a mill scale just what the saving is, but it amounts to probably 10 to 15 per cent of the total bleach needed.

◆ At the completion of the bleaching operation, the pulp should be washed thoroughly to remove any remaining bleach as well as the products of the reaction. It is, of course, desirable to regulate the process so there will be no bleach, or at most only a trace, when the desired color is reached, but this is not always possible. If bleach remains in the pulp when it goes to the beaters, it causes trouble with the coloring of the paper, while if the pulp is dried for storage or shipment, the remaining bleach causes further injury to the fiber as it goes over the driers. Sometimes it is necessary to use antichlors to destroy the remaining bleach, but in well regulated plants this is almost unknown at present. It probably is justified only when a mistake has been made and considerably more bleach has been added than the fiber needs. Under such conditions, the excess of bleach, if left in contact with the fiber, not only would injure it chemically, but it would give it a distinctly brighter color than normal and thus introduce a variable which might be serious during the use of the pulp. Even under such conditions, washing is preferable to the use of antichlors.

Washing also serves another purpose, since it removes the soluble coloring matters which are responsible for much foam in the beaters and on the paper machines. This foaming is not caused by calcium chloride or residual bleach, but by the soluble organic matter. Also, removal of this probably is of importance if the pulp is to be stored in the wet state under conditions which permit the exhaustion of the last traces of bleach. Under such conditions, laboratory tests have proved that there is a serious going back in color of the fiber, but it has not been proved so conclusively in actual mill operations.

The losses during the bleaching operations are of two kinds, chemical and mechanical. The chemical losses are those caused by the oxidation or chlorination and the solution of the products formed. They vary in amount with the kind of fiber and amount of bleach used and rise quite sharply with increase in the latter, especially if a very white color is desired in a single stage bleach. For a normal soda poplar pulp, the chemical loss may amount to about 2 per cent when the color desired can be reached with about 11.5 per cent of bleach. When a higher color is desired and the bleach is raised to 20.5 per cent the loss rose to 3.7 per cent, while 30.5 per cent of bleach raised it to 8.0 per cent. This latter figure is very excessive and far beyond any commercial practice.

Mechanical losses depend so much on the length of the fiber in the pulp, on the nature of the bleaching process, and on the condition of the equipment used that no general statement can be made with safety. It has been claimed that 8 per cent loss is not excessive, but this seems unnecessarily high for any well handled plant in good condition.

In spite of some claims to the contrary, and in spite of the fact that soda pulp from poplar and other hardwoods is short fibered and therefore not considered a strength-giving constituent in the paper furnish, the effect of bleaching on strength is important. The burst, tear and fold of sheets made from soda fiber alone all drop quite sharply from the unbleached strengths, even when small amounts of bleach are used and in distinction from sulphite the strength of soda fiber is never as great after bleaching as before. Moreover, bleaching seems to affect the fiber in such a way that beating produces the maximum burst and tear much more quickly than with unbleached fibers. As already mentioned, the greatest injury to the fiber comes in the last part of the bleaching cycle of a single-stage process. It is not affected to any great extent by differences of temperature of bleaching between 77 and 122 deg. Fahr. It is more serious when bleaching is carried out under acid conditions.

◆ For the control of bleaching operations, care should be taken that the supply of unbleached fiber is as uniform as possible, both in quality and quantity. If the bleach and fiber are mixed continuously the strength and amount of bleach solution are as important as the quality and quantity of fiber. It makes little difference what the strength of the bleach solution is as long as it is uniform and a means is provided for mixing it with the fiber rapidly and completely. Tests should be made frequently and regularly for the bleach requirement of the fiber, for the excess bleach in the fully bleached product, and for the color of the bleached pulp. If a batch process is used, some test should be made to see that each charge is at the proper color before it is dumped to the washer. This can be done by some form of colorimeter or brightness tester.

Bleaching of *Old Paper Pulp*

E. G. MILHAM
Watervliet Paper Company

◆ THE BLEACHING of old paper pulp is a comparatively simple operation since it does not involve the actual bleaching of the fibers. The very marked improvement in the color of the bleached stock is accomplished practically entirely by means of the de-colorization of the numerous stains and impurities embedded within the outer cells of the fibers. Some of these stains arise from the absorption of ink during the printing operation, but more of them are acquired when the fibers come in contact with the brown liquor produced during the cooking operation. The alkaline cooking liquor brings the inks and colors of the old papers into solution making a comparatively strong dye which stains the fibers and is not removed during the washing operation; which, of course, removes the great bulk of the ink and pigment present in the original stock.

The early process for the pulping of old papers was an adaptation of the ancient process for pulping rags and, naturally, the same methods, equipment and chemicals were used. Cooking was accomplished in rotary boilers using lime and soda ash as the softening agent. Defibering and washing was done in the standard Holland beater to which had been attached three or four wire covered wheels for the extraction of wash water and chemicals. The bleaching was accomplished by adding a more or less regular amount of dry chloride of lime (calcium hypochlorite) and vitrol (sulphuric acid). As soon as the bleaching agents had become incorporated with the stock, the entire contents of the beater were dropped into a tank or drainer provided with a porous bottom and a suitable under-drain. In the course of several days, the water and chemicals had drained away rather well and the active chlorine practically had been exhausted. The pulp then was forked out into small wagons and wheeled to the beaters where, as a final precaution, it was given a dose of bleach killer, usually solium thiosulphate or sodium sulphite. The stock was washed again in the beater by means of the well-known extraction wheel in order to remove the last traces of chemicals which experience had shown were exceedingly detrimental to rosin sizing.

◆ From these crude beginnings were developed the comparatively efficient paper de-inking systems in use today. The use of soda ash alone as the cooking chemical is almost universal, although many other chemicals have been used more or less successfully. These include lime, caustic soda, borax, fuel oil, turkey red oil, soap, Bentonite, silicate of soda and numerous combinations of the above. Bleaching chemicals have included calcium hypochlorite solution, chlorine gas, sodium sulphite, sulphur dioxide gas and other combinations containing bi-chromates permanganates or oxalic acid. Of the above list, only the calcium hypochlorite solution in neutral or alkaline stock is in general use today. The reason for the supremacy of the hypochlorite solution lies in the fact that it is comparatively cheap, exceedingly effective for surface bleaching, and practically non-injurious to cellulose fibers in alkaline solution at temperatures under 120 deg. Fahr.

Of course, paper pulp is no longer bleached by the Holland-beater-drainer method although some systems nearly as crude are still in use. At present, most mills are bleaching at 3 to 5 per cent density in an open tank provided with an agitator. The bleaching is carried out at 65 deg. to 80 deg. Fahr., and an amount of calcium hypochlorite solution equivalent to .8 to 1.2 pounds of active chlorine per hundred pounds dry pulp is used. The bleaching solution is left in contact with the pulp for four to six hours after which it is thoroughly washed in the modern decker type washer or a vacuum filter.

◆ A more efficient type of bleaching system is the chain tower in which the stock is treated with the equivalent of about .6 per cent active chlorine and pumped to the top of a cylindrical bleaching tower provided with an agitator. The discharge pipe at the top of the tower is so arranged that the stock is sprayed into the top of the tower and thus thoroughly mixed with air. A standpipe connects the bottom of the tower with the top of the second tower which also is provided with an agitator and is somewhat lower than the first. The stock from the first tower comes up the standpipe and is sprayed onto the top of the second tower. A similar pipe connects the second tower with a third which is lower still and also is provided with an agitator. From there it comes up a third standpipe into a continuous washer.

This system is exceedingly efficient if the towers are made large enough to permit ten or twelve hour contact with the bleaching solution. Of course, a serious objection to this arrangement is that it takes a relatively large amount of room, is rather expensive, and is awkward to clean out. The tower system operates best at 6 to 7 per cent density, and while good results may be obtained at 70 deg. Fahr., much brighter stock is produced if the temperature is raised to from 90 deg. to 100 deg. Fahr. Bleach killer, of course, is not used with this system or with any other modern system because observant papermakers have found that thorough washing *after* bleaching is fully as important as washing before bleaching, and that even moderate washing after bleaching is sufficient to take care of the bleach residues.

The most efficient bleaching system for old paper pulp is the single-stage, high density bleacher operating at 125 deg. to 140 deg. Fahr. With this system, the stock is brought up to 16 to 18 per cent density, or even higher, by means of a vacuum filter, treated with hypochlorite equivalent to .8 per cent active chlorine, brought up to temperature and thoroughly kneaded and aerated by means of a suitable mixing device such as the Fletcher bleacher commonly used in sulphite and soda pulp mills. The time in the bleacher varies from one to three hours, and under normal conditions gives a brighter finished pulp than any of the other bleaching systems in common use. The advantage of the high density system lies in the fact that it gives extremely inti-

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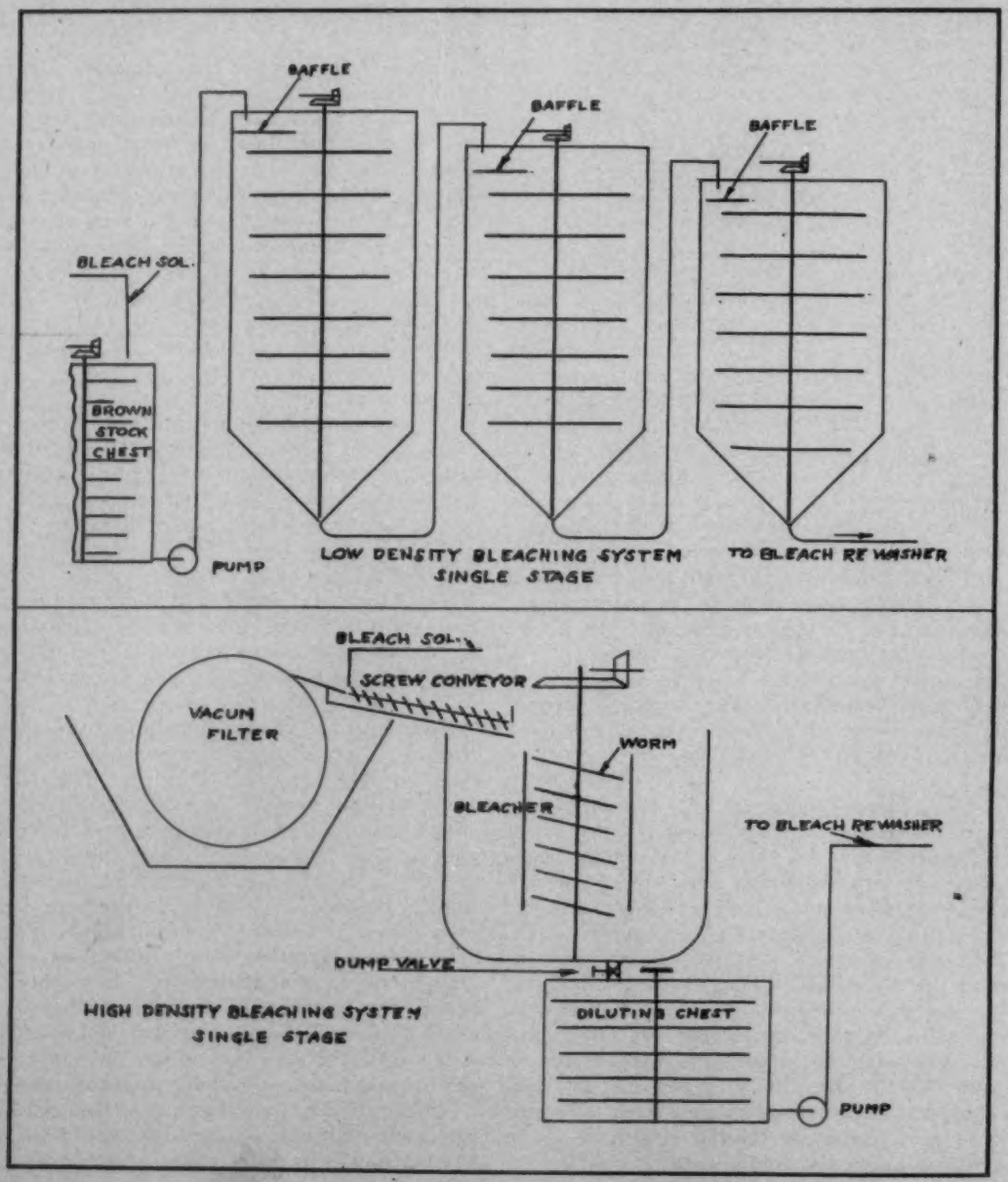
mate contact between stock and bleach. It provides thorough aeration and efficient use of the chlorine consumed. It permits the use of a somewhat higher temperature without an excessive fuel cost as compared with the tower system. It is compact, easily operated and gives exceptionally bright stock. Its application in the old paper field is comparatively recent, but it seems destined to supersede the older, more cumbersome and less efficient systems.

The question may arise as to why larger amounts of bleach are not used in the bleaching of old papers. The reason is that an excess of hypochlorite acts upon the smaller pieces of the fibers and causes a decided deadening of the color. Excess bleach also has a tendency to make the stock slow or "tinny" which is extremely undesirable.

The effect of bleach on the yield is comparatively slight because very little chemical change takes place during the actual bleaching. However, the shrinkage resulting from the washing after bleaching is rather large, often amounting to 5 to 8 per cent of the original paper furnished. The reason for the loss from re-washing lies in the fact that the bleaching operation loosens up many of the small pieces of fibers held together by the water insoluble impurities present in the washed, unbleached pulp. The removal of these impurities is responsible largely for the marked improvement in color obtained when the bleached stock is re-washed thoroughly. If an excess of bleach is used, the shrinkage increases considerably, and, strangely enough, the brightness of the finished pulp drops off, proving that in this case too much of a *good* thing can be very bad.



Paper Sketches ---

To protect their local paper-making industry, the 16th century Dutch made the exportation of paper-making molds an offense punishable by death.

From the Miami Valley of Ohio, pool cars and trucks carried 118,997,329 pounds of paper during 1935, representing a gain over 1934 of 52,042,632 pounds.

Much of the linen stripped from the mummies of Egypt's pharoahs by Arab plunderers and shipped to America, was used as rags for paper-making.

Although 8th century Arabs sized paper with starch, knowledge of this sizing procedure is said subsequently to have been lost and not revived until the 19th century following the introduction of the paper machine.

A remarkable photograph of the acid tower of Weyerhaeuser's new mill at Everett. Use of the slip-form type of concrete construction has resulted in a one-piece shaft, the over-all height of which is one hundred and twelve feet. A corner of the acid plant shows in the foreground on the right.

Weyerhaeuser's

AFTER more than two years of planning and active construction work, the Pulp Division of Weyerhaeuser Timber Company announces its new mill for the manufacture of unbleached sulphite pulp. Situated in Everett, Wash., 28 miles north of Seattle, the new mill is erected on the site selected by the board of directors in May, 1934.

Despite the plentiful supply of timber on the West Coast, the strategic placing of a mill remains of vital importance. When Weyerhaeuser entered the field of pulp manufacture, it opened a mill at Longview, Wash., in proximity to the company's most extensive lumber operation. This meant that the logging operations which supplied logs for the saw mills could be extended so as to furnish raw material for the pulp mill as well. Since 1931, when the Longview mill commenced making bleached sulphite pulp, this arrangement has proved unusually satisfactory.

At Everett, similar considerations apply, since there are two Weyerhaeuser saw mills in the city, both of which require a steady supply of logs. The West Coast hemlock used in making unbleached sulphite arrives at the new mill in huge rafts, the logs of which are stored in water near the break-down plant. Built on ground formerly occupied by Weyerhaeuser's first West Coast saw mill, the new pulp mill has taken over one of the old buildings and reconstructed it for use as a break-down plant.

Shipping facilities, another of the considerations in choosing the site for this pulp mill, are exceptional at Everett. The new mill is erected alongside the waters of Pudget Sound and extending from the pulp storage shed is a dock

The wash-water tank at the filter plant of Weyerhaeuser's new unbleached sulphite pulp mill. This plant, situated a mile from the mill site, is erected at a level of 240 feet above that of the mill floor. A portion of two of the wooden filter beds shows in the foreground. There are eight of these beds in all, each of which is capable of handling two million gallons of water every twenty-four hours.

One end of a settling tank of the unique filter plant of the new pulp mill. Enormous timbers support the Douglas fir used throughout the construction of this plant.

New Pulp Mill

accessible to ocean-going vessels capable of carrying pulp to any seaport in the world. There are, as well, convenient connections with the great transcontinental railroads.

The Pulp Division once again secured the services of O. C. Schoenwerk, the designer who laid out Weyerhaeuser's Longview mill. Ever since March of last year, when work was begun at Everett, Mr. Schoenwerk has been on hand, keeping in constant touch with all phases of construction. During this period, the Pulp Division also maintained a small office force at Everett.

One of the many unusual features of the new mill is the filter plant. A mile distant from the mill site, this plant is erected at a level 240 feet above that of the mill floor, an arrangement which assures a constant head on the purified water used in making unbleached sulphite at Everett. The original source of water is situated a hundred feet above the filter plant, furnishing a steady supply of raw water to be purified before being stored in the clear well at the filter plant. Douglas fir was used throughout this plant. Each of the eight filter beds handles two million gallons of water daily.

First completed building of the new mill was the pulp storage shed which was erected while excavation and pile-driving were in progress prior to the erection of other buildings and tanks. For different phases of the construction work, the Pulp Division let contracts to various contractors. All concrete construction, for example, was in the hands of Alloway and Georg of Spokane.

Wherever possible, the slip-form method of construction was used on concrete

Rising majestically in the foreground is the digester house of Weyerhaeuser's new unbleached sulphite pulp mill. The walls of this monumental structure form a one-piece shell of steel-reinforced concrete, enclosing the six digesters in a building ninety feet high. The picture, taken during the last stages of construction, shows work in progress on the blow pit tanks at the lower right.

A striking picture of one side of a settling tank of the filter plant. This plant provides a constant supply of purified water for use in making unbleached sulphite at Weyerhaeuser's new mill at Everett.

buildings. This type of concrete construction involves the building of a mould, six feet deep, designed in the shape of the exterior walls of a building. Concrete is poured into this, and as it hardens, the forms are moved up by jacks until the desired height is reached. The acid towers, which rise 112 feet, and the 90-foot digester house, were built this way. Steel reinforcements and all apertures were placed as the buildings went up. The same method was applied to the walls which encase the two accumulators as well as to the walls of the machine room, a building 360 feet long.

The chip storage building is constructed entirely of wood. It contains twelve chip bins, running crosswise the full width of the building or 82 feet. The chips are carried to the top of the digester house by means of a conveyor belt which is set in operation whenever a digester is being charged. Control over the belt and the chips coming from storage is exercised by the cook in the digester house.

The mill is remarkable for its line operation: that is, for the arrangement of the buildings in which successive stages of production are carried forward. The chipping plant, 182 by 126 feet, stands opposite the break-down plant and directly beside the chip storage building. Next come the sulphur storage building, the acid plant with its tower, and the accumulators. The digester house follows and is separated by the blow pits and a series of tanks from the screen room, a building 144 feet long and 100 feet wide. Next comes the machine room and just opposite is the pulp storage shed. The beauty of individual structures, coupled with their placement in relation to each other, make Weyerhaeuser's new mill outstanding among the country's industrial units.

R. B. Wolf, manager of the Pulp Division, and G. S. Brazeau, who has been appointed plant manager at Everett, have taken from Weyerhaeuser's Longview mill many of the men who have assumed new duties at Everett. Vacancies created at Longview were filled by promotions.

In the course of operations at Longview, men of the Pulp Division have arrived at solutions to various problems connected with pulp manufacture. They have incorporated their knowledge in planning and constructing the new unbleached sulphite pulp mill at Everett.

Jacob Kindleberger Chairman of Board—New Titles and Promotions at K. V. P.

COMPARATIVELY few business men achieve the realization of an idea. Many dream but give up under the burden of great obstacles. And many who do in a sense realize their hopes and ambitions are overcome by the monetary aspect of their possessions and lose sight of their early idealism.

Twenty-six years ago, Jacob Kindleberger dreamed of building a great and modern paper mill—an organization that should stand in a community where lived the men who worked there—men who would face with him the task of building such an institution.

And today, "Uncle Jake" Kindleberger, whose faith has never wavered, whose steadfastness of purposes has withstood prosperity, and whose philosophy has become widely known, sits in his office in the ten million-dollar plant of the Kalamazoo Vegetable Parchment Company at Parchment, Michigan, and says:

"Am I happy? I'll tell the world I am! To make a program and live long enough to complete that program—that is the source of my happiness.

"What is this program? First, to have a part in building an industry and to build that industry on a solid foundation so it will weather the storms. To have that company known throughout the world as a good company, an efficient company, a concern that serves the world efficiently and satisfactorily,

Jacob Kindleberger

equipped with the best machinery and gadgets that it is possible to buy.

"Next, to have an organization of men who are efficient, who are loyal, and who are imbued with the spirit of serving; to have these men hitting on all cylinders so they can be promoted and entrusted explicitly to carry on."

In becoming Chairman of the Board, Mr. Kindleberger rewards executives in his organization with titles and promotions they have earned. This is understood as a gesture of appreciation and does not mean that he will be less active in managing the company. He will continue to be the guiding hand of K. V. P.

R. A. Hayward, who becomes the new president and general manager, has a through background of paper mill experience, twelve years of which have been spent in the K. V. P. organization.

A. Southon, who is advanced to first vice-president in charge of sales and a place on the board of directors, thus earns a reward for almost twenty-five years of service with the company.

H. H. Jones, who becomes third vice-president, has been with the company nearly 18 years advancing from stenographer to that of sales manager of the waxed paper division.

Other officers re-elected are: James Greenlee, 2nd vice president; C. S. Campbell, treasurer; T. W. Peck, secretary; and W. R. Hess, assistant secretary.

Wood Room at Bogalusa Paper Company

T. T. DUNN, Plant Engineer
Bogalusa Paper Company, Inc.

THE pine woods of the South provide a large part of the pulp for the domestic kraft paper industry. In Eastern Louisiana, the Bogalusa Paper Company is a large producer of kraft paper. Natural second growth and reforested pine provide most of the raw material used in this region.

The mill of the Bogalusa Paper Company dates from 1917. The wood room built at that time was used until 1935 when it was replaced by a new installation with a different arrangement.

The wood room as originally constructed had one drum-type barker, two chippers, two screens and two re-chippers. The wood was unloaded from railway cars to a chain-type conveyor. This conveyor dropped the wood into a short chute leading to the barking drum in the basement of the wood room building. Another conveyor transported the wood from the discharge end of the barking drum to the ground floor where it was fed into the chippers by attendants. The chips fell from the chippers into the basement where they were picked up by two bucket-type elevators and raised to a position from which they might be dropped on the screens. The chips from the screens passed through the floor in the chute to a belt conveyor which carried them up to the chip bins.

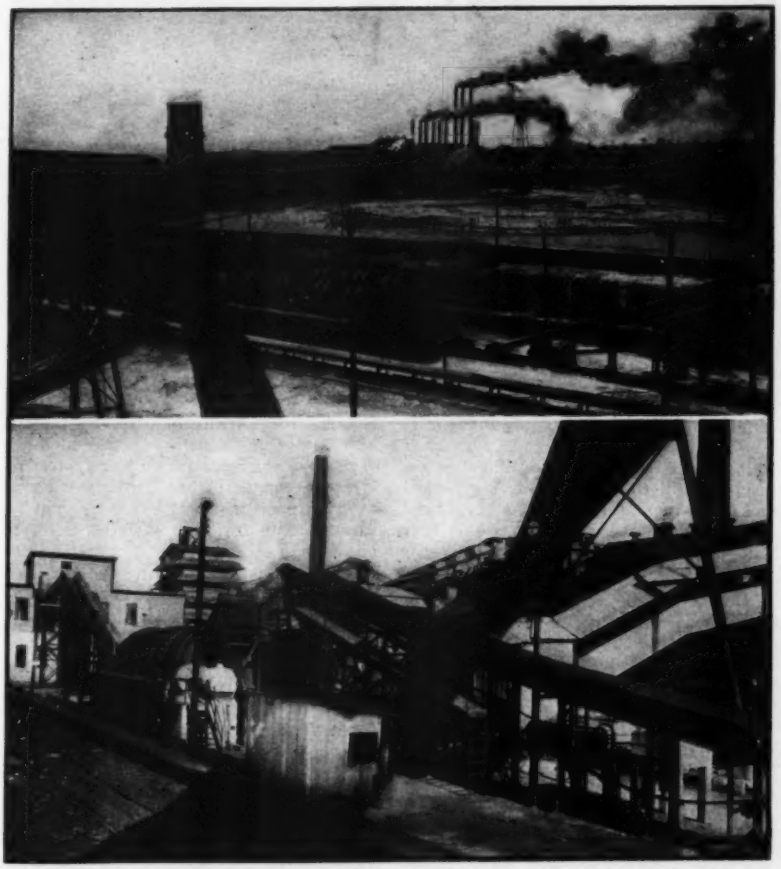
All of the old wood room equipment was driven by belts. The elimination of all belt drives and the reduction to a minimum of conveyors was desired.

It was important that the construction of the new wood room equipment must in no way hamper the operation of the old equipment. Fortunately the old equipment was so located that this requirement did not necessitate any compromise in the design.

Briefly stated, the design problem was as follows: two barking drums above ground level with facilities for transporting pulpwood from cars to drums; means of removing bark from under the drums to a fuel bin in the top of the power house; and transportation of the wood from the barking drums to the chippers, then to the screens, and from the screens to a belt conveyor leading to the chip bins.

The wood room arrangement described herein was designed by the engineering department of the Bogalusa Paper Company, Inc.

A single long Link-Belt chain conveyor is used to carry the wood to the two barking drums; the chain runs in a trough made of one-half inch steel plate. The trough is one foot eight inches deep and three feet and no inches wide. Wear from the chain is taken by a fifteen-inch channel fastened in such a manner as to be readily renewable. This conveyor is four hundred feet long, two hundred and thirty feet being horizontal, and one hundred seventy feet curving up to a height of twenty-six feet where it discharges into a double chute which divides the wood equally between the two barking drums, which are special design Branch Drums manufactured by the D. J. Murray Manufacturing Company.

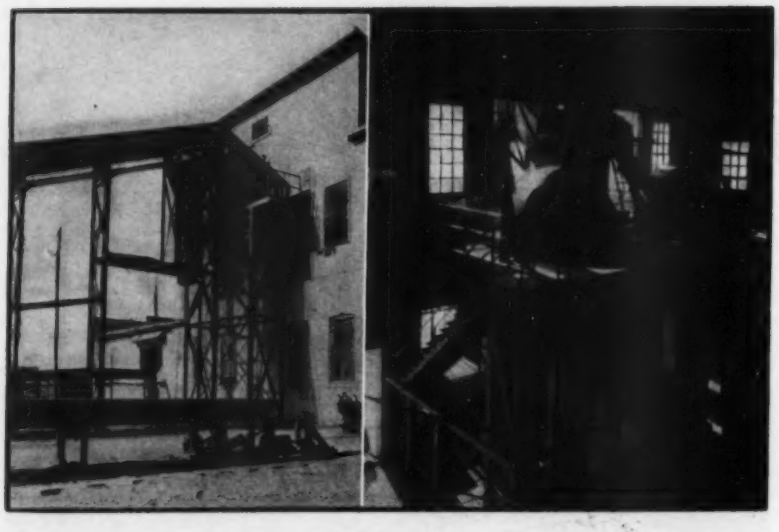


Above—View of barkers and conveyors. Bark conveyor in left center covered with light colored material. Below—Looking toward wood room from point alongside first pulpwood conveyor.

The track is run on each side of the conveyor to a point where it is too high to load from the cars conveniently. Decking beside and between the tracks at the lower end of the conveyor provides a smooth runway for trucks when motor transportation is used for the pulpwood.

The barking drums are twelve feet in diameter and forty-five feet in length. Each drum is in three separate sections. They turn in such a manner that the tendency of travel of the wood is away from the common center. The axes of the barking drum are horizontal. At the discharge end are dams constructed from twelve-inch ship channels which are bolted in place in order that by the removal or addition of channels the quantity of wood in the drums may be regulated. The barking drums are supported by a single solid concrete foundation. The bark drops through the openings between the ribs of the drums into steel plate hoppers which direct it onto two Link-Belt chain conveyors moving under the barking drums in a direction opposite to that of the pulpwood conveyors. These chain conveyors feed the bark to a Link-Belt belt conveyor which runs directly to storage hoppers in the fuel house.

On the discharge end of each barking drum is a chute which receives the wood as it comes over the dam. These chutes converge into the trough of a conveyor of similar cross-section to the first pulpwood conveyor. The chutes were care-



Left—View of upper end of barked pulpwood conveyor and chutes to chippers

Right—View inside wood room showing chippers and foundation.

fully worked out experimentally to reduce battering action of the wood and to prevent piling up. The conveyor is straight but inclined in such a manner that it rises from a point nine feet below ground level to a height of thirty-eight feet above ground level with a horizontal projection of one hundred twenty-four feet. As the wood enters this conveyor it is sprayed with water for the purpose of removing dust and loose bark. Slots in the bottom of the conveyor allow the water to drain out.

There are two ninety-six inch Murray chippers driven by direct-connected Electric Machinery Manufacturing Company synchronous motors of two hundred fifty horsepower each. The chippers are spaced fifteen feet between center lines and eighteen feet above ground level. Wood drops off the conveyor onto a divided chute which passes through the wood room wall into the chipper spouts. Two chutes are joined together at the top by a ridge which lines up with the center line of the conveyor. The wood falls to either side depending on the way it lies in the conveyor. The division is approximately equal. The feeding of the chippers is entirely by gravity, the chutes being long enough to prevent the wood piling up under ordinary conditions.

The chipper foundation is all reinforced concrete; the chipper platform, thirty-three feet by sixteen feet five inches, is supported by eight concrete columns two feet three inches square. The chippers are at a height of thirty-one feet from the basement floor. A concrete platform fills in between the columns at the ground floor level. The structure is entirely isolated from the wood room building to prevent transmission of vibration. There are three Rotex screens, manufactured by the Orville Simpson Company, all of which are of the low angle, reciprocating type. One large screen is placed directly back of each chipper while the third screen, a small screen for resized chips is off to one side.

A belt conveyor starting in the basement of the wood room conveys the chips to the chip bins in another building. The flow of chips all the way from the chippers through the screens to this conveyor is entirely by gravity. Because of the fact that chips too large to pass through the screens must be broken up and re-screened, two additional Link-Belt belt conveyors were required. The chips and slivers which do not pass through the two large screens drop from the foot of the screens to the belt conveyor which discharges through a divided chute into one of two Lombard chip crushers. These crushers discharge the re-sized chips on another belt conveyor leading to the small screen. Any chips or slivers which fail to pass through this screen repeat the cycle.

Fines, or small chips, pass through openings in the bottom of the screens into ducts, and are blown to the fuel bin by means of a pneumatic conveyor system.

All motors are controlled by push button switches. The relays operating the circuit breakers are interlocked so that shutting down one piece of equipment stops those behind it in the cycle. This prevents the pulpwood from piling up when one machine stops. The main control panel is placed in a control room on top of the wood room, directly above the chippers. The operator at this control panel has a commanding view of all equipment in the wood room and outdoors, with the exception of the bark conveyors. Controls for the bark conveyors and duplicate controls for the pulp wood conveyors and barking drums are located near the receiving end of the barking drums. The two control stations give quick and complete control of all wood room operations with a minimum number of operators.

View inside wood room

Twenty-Third Meeting of Canadian Technical Section

THE Technical Section of the Canadian Pulp and Paper Association held its twenty-third annual meeting in Montreal last month. Following the precedent established last year, the sessions extended over three full days, January 29, 30 and 31, and one of the sessions was held jointly with the Woodlands Section to discuss problems of interest to both groups of technicians. In addition, an equipment exhibition at which about fifteen manufacturers of pulp and paper machinery showed their products was held in the Mount Royal Hotel, and was visited by many of the members in attendance at the meeting, and on Saturday morning, February 1, demonstrations were given at the Pulp and Paper Research Institute illustrating the working principles and possible applications of various new testing devices which have been evolved by senior staff associates. These included the opacimeter, a pulp area measuring device and a conductivity method of determining the consistency of pulp suspensions. The procedures that are being followed in other programs of investigation were also opened to inspection of the members.

Brigadier-General J. B. White, president of the parent association, being detained at home by illness, sent his greetings to the assembled membership. He referred to the fact that the industry had been passing through very hard times, that had not yet come to an end; but through all this trying period the technical men had unrelentingly continued their good work. The two main events in the life of the Section during the past year were: (1) the nomination as Technical Advisor to the Joint Administrative Committee of W. G. Mitchell, whose function of co-ordinating the work of the Section with that being carried out at the Pulp and Paper Research Institute was already producing good results and held promises of still greater advantages, and (2) the formation of the Ottawa Valley Branch of the Section, which has grouped a large number of the technical men of the industry located in the Ottawa district and promises to be fertile in results through the increased opportunities thus afforded of exchanging ideas.

The reports of the Chairman of the Section and of the various committees having been previously distributed in printed form, they were given merely formation presentation, the respective chairmen saying only a few words to draw attention to the more important points dealt with therein.

Steam Generated by Electricity

C. R. Reid, assistant general superintendent of the Shawinigan Water and Power Co., read an interesting paper on the *Electric Generation of Steam in Paper Mills*, as a means of utilizing surplus hydro-electric power. Electric steam generation, a child of hard times, was first introduced about 1921, and since then has grown to very respectable proportions. The installed capacity in Canada at the present time is about 1,500,000 kilowatts, about 80 per cent of which is to be found in the pulp and paper industry. Mr. Reid touched briefly on the quality of electrically generated steam, on the automatic control of steam pressure or power imput, and on the relative costs of coal—and electrically-generated steam. He dwelt at somewhat greater length on the problem of the presence of gas (and more particularly hydrogen) in the steam and on the consumption of electrodes due to corrosion and erosion. With ordinary soft water, such as is generally available in Quebec mills, the wear is very slight and electrodes should have a normal life of about three years. The problem raised by certain natural waters which produce high erosion has been effectively solved by the use of alloy steel electrodes. Numerous slides illustrated the principles of the different types of electric steam boilers and showed numerous installations in Canadian pulp and paper mills. E. T. Brandon, of the Hydro-Electric Power Commission of Ontario, made a few pertinent remarks, more particularly as regards current density which he considered should not be permitted to rise much above 1 ampere per square inch. Maurice Nielsen contributed to the discussion some reminiscences of the operation of the first electric steam boiler in Canada, installed in the Shawinigan Falls mill of the old Belgo-Canadian Pulp and Paper Company.

The Fair System

R. E. Hayes, of Ontario Paper Co., read a paper on *The Fair System of Furnishing Filler to Paper*. In this system, the filler is introduced into the paper as a slurry which is added directly on the fourdrinier wire, at a point which is selected so that the quantity which drains through the wire is a minimum. The apparatus consists of a curved metal shield covered with corrugated rubber covering material and provided at its lower edge with a soft rubber or oilcloth lip. Mr. Hayes described the performance of the system in the manufacture of newsprint and compared the results with those obtained by the usual method of adding the filler in the beaters. The ensuing discussion was extended to the application of the system to papers other than newsprint. Mr. Fair, inventor of the system, gave a most interesting outline of its origin and development; the possibilities of the system have not been completely worked out, but they are being investigated, and though the results are not yet ready to be released, they would indicate that a very wide range of sheet characteristics can be obtained from little or no two-sidedness to very considerable differences in the two surfaces of the sheet; as to the extent to which filiers could be incorporated, he had obtained experimentally a sheet containing 40 per cent of ash.

Major-General McNaughton Luncheon Speaker

At the luncheon, C. C. Heritage, president of Tappi, extended a most cordial invitation to all members of the Section to attend the convention of his association which will be held in New York next month.

The Section was privileged to have as guest speaker Major-General A. G. L. McNaughton, president of the National Research Council of Canada, who spoke on *The Relation of Research to Industry*. After tracing the history of the National Research Council back to its inception in 1916, General McNaughton showed the importance of carrying out research in Canada by Canadians for Canadian industry, rather than the depending on work done abroad as is too often the case with Canadian companies affiliated with powerful organizations in other countries. Pleading for greater support on the part of the industry of the Forest Products Laboratories of Canada and the Pulp and Paper Research Institute, he declared that the denial of such support would prove "the most expensive retrenchment ever made." The speaker referred to the formation by the National Research Council of a nation-wide committee on problems relating to forestry, and assured the meeting that this committee was at their disposal to help out in any way it could in the solution of their problems.

Trends in Sulphite Digester Operation

The afternoon session opened with a paper on *Current Trends in Sulphite Digester Operation* by R. T. Steedman of Anglo-Canadian Pulp and Paper Mills, in which the author went to considerable trouble to indicate a procedure of evaluating the actual performance of a sulphite digester so that data might be available from which to estimate the actual benefits of proposed new digester equipment. The paper brought out the complexity of the problem, and this was still further emphasized in the course of the animated discussion which followed the presentation of the paper and which again brought up that hardy perennial, the determination of pulp yield. Con-

siderable interest centered around the question as to whether or not systems such as the Chemipulp were responsible for the "holding" of pulp in the digester and prevented obtaining clean blows; and the argument had to be declared a draw as experiences were practically equally divided on the subject.

Sulphur Consumption Control

The next paper was by C. B. Davies, of Abitibi Power and Paper Co., who spoke on the *Control of Sulphur Consumption in the Manufacture of Sulphite Pulp*. Mr. Davies described the Superior Relief SO_2 Recorder, a modification of the Sisler-Cooper SO_2 Recorder developed at the Sault Ste. Marie Division of Abitibi, and presented actual mill operations results illustrating the sulphur economy possible through proper control of digester relief. He claimed that, by the application of this instrument, the pulp and paper industry of Canada can save $1,000,000 annually in the cost of sulphur when operating at 75 per cent of the rated sulphite mill capacity. The discussion of the data presented brought some rather unexpected statements from Horace Freeman, of Consolidated Paper Corp. regarding losses of sulphur in acid manufacture through formation of sulphur trioxide, the loss, according to Mr. Freeman, reaching as high as 25 per cent; but the replies of sulphite mill operators indicated that they were not convinced by his arguments.

The Use of White Pigments

In the last paper on the day's agenda, J. J. Crawford, of Howard Smith Paper Mills, described a series of very interesting experiments carried out on the *Use of White Pigments in Paper*, in which he compared the relative effects of titanium dioxide zinc sulphide, normal lithopone and Titone-P (a commercial product containing about 15 per cent titanium dioxide and 85 per cent lithopone). For good retention, the use of rosin size (or some equivalent material) is essential; best retentions are obtained by admixture with rosin size before addition to the beater; failing this, the pigment should be added *before* the alum. However, the precipitation of colored matter on the pigment particles when the alum is added *after* the pigment defeats the advantage gained by higher retention in cases where appreciable quantities of foreign color are present. The Mullen strength is adversely affected, to approximately the same extent for each pigment, as the degree of pigmentation is increased. Lithopone is the least effective in respect to improving color, but nevertheless the improvement is very marked.

Replying to a question by Mr. Emory, Mr. Crawford stated that experiments were at present under way regarding the effects of pigments on the printing quality of paper, but they had not yet proceeded sufficiently far to warrant publication of the results. James d'A. Clarke, of Scott Paper Co., raised some doubts as to the practical application of Mr. Crawford's results, because conditions on the paper machine wire differ very greatly from those in the British sheet machine, which was used for the tests, J. N. Stephenson, editor of *Pulp and Paper of Canada*, suggested two points which should be borne in mind in studying pigments in paper, namely, their possible influence on the dulling of cutter knives, and the production of "dusting" on the printing presses.

Freeness and Bursting Strength of Groundwood

At the opening of the Thursday morning session, owing to the absence of the author, L. E. Kendall, of Abitibi, read a paper prepared by H. A. Paterson, of Mersey Paper Co., on *Groundwood Quality Expressed by Freeness and Bursting Strength*, in which he showed that, by expressing in a suitable manner the relationship between the freeness and bursting strength of groundwood, it can be used reliably as an expression of groundwood quality by means of which valid comparisons of different pulp can be made. The manner of expressing the relationship presented in the paper consisted of a set of curves in which Mullen test was plotted against Canadian standard freeness for a large number of different quality groundwoods, but the author warned that the lines in the region of high quality may be less reliable, and more work should be done on that part.

H. B. McAdam stated that in his mill a series of tests had been carried out by selecting one stone the degree of sharpening of which was continuously increased, and comparing the results of screen classification with changes in freeness and strength, and they arrived at the conclusion that there apparently was no relationship between classification and freeness. It would seem that the paper just presented furnished a new relationship and a new method of evaluating groundwood quality. In reply to V. H. Emory's inquiry as to whether the use of a certain strength at a given freeness was actually being used in the control of groundwood mill operations, Otto Brauns stated that it has been in use for a number of years in the Abitibi group of mills; it was doubtful, however, where the method was sufficiently sensitive to be of much value unless the variations in the groundwood were quite large. James d'A. Clark, of Scott Paper Co., said he could see very definite advantages to groundwood buyers in the system presented by Mr. Patterson. He went on to say that it was most important to establish a correlation between the qualities of pulp and of the paper produced from it, and in this connection one characteristic which seems to have attracted little or no attention was the blending quality of the groundwood with sulphite. He ventured to suggest that possibly too much importance is attached to the physical testing of pulp; after all, the proof of the quality of pulp lay in the paper made from it, and it did not seem quite reasonable to expect to judge the properties of paper entirely from the corresponding quality of the pulp any more than to judge the strength of concrete from that of the stones used in making it. W. C. Lodge, referring to the blending quality mentioned by Mr. Clark, stated that little or no reliance could be placed on laboratory-made sheets, as these seem to have no constant relation with machine-made paper. Mr. Clark replied that the difference was quite possibly due to the different amounts of fines retained in laboratory-made and machine-made papers, respectively, and he went on to say that present testing methods must be used cautiously, as they could give very misleading results. Professor Harold Hibbert suggested that the nature of the electrostatic charges on the particles of fines and on the larger fibers, and also the amount of water dispersed around the fines were factors that had not yet been investigated and that might exert considerable influence in modifying the binding qualities of the pulp.

Formation and Structure of Cellulose

The program committee had been very fortunate in inducing Dr. Wanda K. Farr to come to Montreal to describe before the Section the most fascinating investigations she is carrying out at the Boyce Thompson Research Institute on the *Formation and Structure of Cellulose*. Dr. Farr presented her subject in a wonderfully clear and simple manner by projecting on the screen and explaining a series of microphotographs in an orderly sequence which showed the progress of the work carried out since its inception up to the very latest results obtained. The equanimity of the cellulose chemists was rather considerably upset when Dr. Farr described some very recent experiments which tend to prove pretty conclusively that, contrary to generally accepted ideas, pure cellulose is insoluble in cuprammonium solution. Dr. Emil Heuser epitomized the situation as follows: "Dr. Farr says cellulose is insoluble in cuprammonium solution; yet we cellulose chemists know it is soluble because we dissolve it." Professor Hibbert tried to reconcile the two opposing views, but the results of further experiments must be awaited before the solution of the problem is found.

New Officers Elected

The Section then proceeded to elect the following officers for the ensuing year:

Chairman: H. J. Rowley, Anglo-Canadian Pulp and Paper Mills.

Councillors: Elliott Little, Anglo-Canadian Pulp and Paper Mills; W. B. Scott, Manager of the Laurentide Division of Consolidated Paper Corp., and E. D. Hyndman, manager of St. Lawrence Paper Mills.

Representative on Joint Administrative Committee: W. S. Kidd, E. B. Eddy Co., retiring chairman of the Section.

Prof. Morgan Speaks at Joint Luncheon

After the luncheon, which was a joint one with the Woodlands Section, the speaker, Principal Arthur E. Morgan of McGill University, had selected the same subject, *Research*, as General McNaughton at the preceding day's luncheon, but

he treated it from an entirely different viewpoint. Just as in life the individual cannot remain stationary but must inevitably go on, so industry is caught in the swirl of movement known as modern civilization. The absolute necessity of research is a generally accepted fact. But the greatest problem before civilization at the present time is not technical and scientific research for the development of new products and the improvement of processes of manufacturing new products; it consists in research in fields of marketing, distribution and sociology, to permit that the benefits of scientific and technical research might be made available to the large mass of human beings who cannot as yet benefit by them due to factors and conditions entirely outside the field of scientific and technical development.

After luncheon, the Technical Section met jointly with the Woodlands Section to discuss marginal problems of interest to both.

Variation in Density of Pulpwood

J. D. Hale, of the Timber Physics Division of the Pulp and Paper Laboratories of Canada, presented a paper prepared by himself and J. B. Prince, in which were described the data accumulated since last year's meeting in the course of their *Study of Variation in Density of Pulpwood.*

Mr. Wright, of Price Brothers, was anxious to know whether the density of wood in a stand could be obtained with a reasonable degree of accuracy from bush data on spruce and balsam. Mr. Hale replied that the mere counting of the growth rings on the stump would not be sufficient to calculate the density accurately; it would be necessary to make counts at a reasonable number of intervals along the length of the log. L. Anderson, of Ontario Paper, was a staunch believer in the value of density determinations. It was necessary to follow the cuts in the woods, but the Woods Department made use of the results obtained in the mill. One of the great difficulties lay in obtaining satisfactory checks. Owing to conditions at his mill, where some 150 shiploads of pulpwood were received during the navigation season, time was one of the controlling factors in testing. The method adopted, though not strictly accurate, gave consistent results which checked fairly well with those of Hale. Mr. Claridge stated that the question was of considerable importance to his company as they secured their wood from a very wide area extending from north of Lake Superior to Southern Nova Scotia, and they had studied the matter extensively. It was their experience that with balsam there was little or no variation in density, while with spruce it might amount to 10 per cent or more. The average density of the wood from a given region was correlated with the relative percentages of spruce and balsam, and this, in conjunction with wood analyses and yield tests, was used in working out the basis of payment for pulpwood. At the request of Mr. Kidd, C. C. Heritage gave a brief outline of the work that has been carried out for the last 12 years by Oxford Paper on the development by hybridization of rapid growing trees suitable for pulpwood.

Conversion Factor Tests

W. G. Wright, of Price Bros., chairman of the Sub-Committee on *Measurement of and Conversion Factors for Random Piled Pulpwood*, next presented a report in which he described the results of a number of conversion factor tests carried out in various mills, invited member companies to submit data on any further such tests and suggested that such tests be carried out in accordance with a standard scheme, insofar as this was possible. The results indicated that it was impossible to work out a general factor that would be applicable to all mills, and that each mill should work out its own factor that would depend on the conditions prevailing there. While a number of the members seemed doubtful as to the value of obtaining such a figure and to the necessity of going to the trouble of determining it, Mr. Kennedy emphatically proclaimed that it was vitally important to both the woods departments and the operating departments to get at the true cost of the wood, which was the most important raw material entering into the manufacture of paper, and that this was the only possible way of getting a decently close cost figure on the wood used during the year.

Deterioration of Stored Pulpwood

The final paper of the afternoon was one by Dr. Clara W. Fritz, Chief of the Division of Pathology of the Forest Products Laboratories of Canada, who reported on results obtained since the 1933 report on the study of the *Rate of Deterioration of Pulpwood in Storage.* The irregularity of the results obtained to date indicate the necessity of examining huge numbers of samples in order to obtain reliable and truly significant results, and this would be quite impractical on account of the small personnel of the Division of Pathology and the large amount of work required for testing each sample. The purpose of presenting the paper was merely to bring the problem to the attention of those interested, so that they might decide as to the advisability of continuing the investigation and if possible indicate means of advancing it more rapidly.

Pulp and Paper Institute Activities

The final day of meeting was devoted to work which is being carried out at the Pulp and Paper Research Institute.

Dr. W. Boyd Campbell first read a paper on *Screen Classification of Pulp*, in which he outlined the work carried out in an endeavor to show how reproducible were the results obtained with the screen classifier developed at the Forest Products Laboratories when one instrument was used by different operators and how much tolerance could be safely allowed on different instruments. As a result, certain modifications were made, and it could now be concluded that in its present form a design could be fixed which would be reasonably reproducible and which, without requiring an undue amount of experience on the part of the operator, would give reproducible results.

James d'A. Clark said that for a couple of years he had been using a similar but simpler instrument with which results could be obtained in about twenty minutes and which was quite practical for control work; but he was disappointed that the results were not more significant—they were consistent and easily reproducible, but their true meaning was not apparent as large changes in the stock were reflected only slightly in the classification test. As far as he could see, the making of hand sheets was a more valuable test.

L. E. Kendall stated that he had had experience in the classification of mill stock. Classification was carried out regularly on both bull-screen and regulator stock, and the results were used in making up the mill flow sheets. However, the tests did not check up with mill operations, there being considerable discrepancies between the calculated and true tailings and white water. When used on bull-screen stock the classifier seemed to hold coarse stock in the fine fractions, while on the regulator stock it seemed to pass on fines with the coarse fractions. Dr. Campbell remarked that the comments of Mr. Clark and Mr. Kendall showed the advisability of not releasing prematurely a new instrument for general use in the industry. The classifier had now been developed to a point where it was practically usable, but before placing it on the market it remained to ascertain whether the industry wanted or needed the information which it can furnish.

Professor Keay explained that the end in view when the work on classification was started was to determine what was the optimum blend of fine, medium and coarse fibers for a given purpose. Trouble was soon encountered, and still is, with overlapping of fractions, and he wanted to know whether uniform overlapping could be counted on; to which Dr. Campbell replied: "To a very considerable extent, yes."

While classification work was started with the preconceived notion of separating pulp into fractions of different fiber lengths, said Dr. Sankey, work on fiber blending had shown that this notion was mistaken; but the application of the classifier may prove of value in fields quite different from those originally expected.

J. N. Stephenson remarked that judgment on the instrument should not be allowed to crystallize as yet. Changes had just recently been introduced in its design and manipulation, and it was only fair to give it a chance to show what it could do in its present form.

Rate of Expansion by Moisture Adsorption

Dr. G. Larocque, of the Pulp and Paper

Research Institute, gave a quite remarkable paper on the *Extension of Paper by Adsorbed Water Vapor*, in which he presented a large amount of data on the rate of expansion, by moisture adsorption, of several different kinds of paper at 20 and 50 per relative humidity and 25 deg. C., both in vacuo and in air. He drew the most interesting conclusion that, when paper is subjected to an environment of 70 per cent relative humidity or greater, the strains present in the paper as a result of the manufacturing process are released, and there is a permanent alteration in the paper dimensions; the subsequent moisture-extension behavior of the paper is then more regular than it was before, so that a relatively short conditioning of paper at a high humidity (about 85 to 95 per cent) should greatly reduce the likelihood of curling, wrinkling and mis-register.

At the conclusion of Dr. Larocque's talk, A. E. H. Fair commended him on having carried out a constructive piece of work of great value to both paper makers and printers. Dr. Maass, under whose direction the work is being carried out, explained that it was not by any means finished as yet; there still remained to find out whether extensions were best represented on the basis of relative or absolute humidity and also to investigate the effects of temperature. He then presented the very latest data obtained by his co-workers which showed curves of extension plotted against relative humidity, absolute humidity and moisture content of paper after conditioning at high humidities.

C. N. Candee congratulated Dr. Larocque on having indicated a practical method of releasing or minimizing the strains in paper that are detrimental to printing. Dr. Sankey considered that the most important and outstanding feature of the work lay in the fact that it gets down to the very fundamentals of paper as a material to be used in another industry. Mr. Shipman, of Donnacona Paper, remarked that he foresaw immediately possibilities of applying Dr. Larocque's findings to the solution of some of the vexing problems facing the building board manufacturer.

The Maass Photoelectric Opacimeter

Dr. Maass next presented his paper on *Opacity Measurements as a Means of Measuring the Influence of Some of the Variable Factors Affecting the Optical Properties of Paper.* The dynamic photoelectric opacimeter, developed by Dr. Maass, can be used to measure the absolute value of the amount of light transmitted by paper, and he showed that by measuring the light transmitted by one sheet and the amount of light transmitted by two sheets, the reflectance, printing opacity and contrast ratio can be calculated. This procedure was used to investigate the optical characteristics of paper as influenced by wet pressing, groundwood and sulphite contents, fiber length and beating; and it was shown how all these data could be presented on the same basis weight and that the variation of one factor at a time could be followed, the others being kept constant. It was emphasized, however, that though transmittance could be calculated from reflectance, and vice versa, it was preferable to determine both properties by direct measurement.

Mr. Clark suggested that a consideration of the bulk of the paper might be very helpful in the interpretation of the results. Mr. Vivian, who had carried out many of the measurements reported, replied that bulk measurements had been made, but the change in bulk produced such small variations in transmittance that it was not considered worth while to do any more work in this connection. This Mr. Clark was inclined to attribute to the fact that the bulk was determined on single sheets, which gave much less accurate and consistent results than a determination carried out on a stack of several sheets, and he insisted that work in this direction might give interesting and useful results.

The possibility of using the opacimeter to determine the percentage of sulphite and groundwood from surface area measurements also came in for quite a little discussion; and it seems somewhat doubtful whether such a method could be worked out satisfactorily as it must be based on the optical characteristics of slush groundwood and sulphite on the one hand and on those of the disintegrated paper suspension on the other, and a large amount of fines are lost on the paper machine wire.

Paper Testing Trends

At the final session of the meeting Dr. W. Boyd Campbell gave a brief talk in which he outlined the *Trend of Paper Testing.* Dr. Campbell stated at the outset that his paper was, so to speak, all breadth and no depth; it was not intended to convey any new information, but rather to start a discussion which would show what the industry needed and wanted in the matter of testing. The results were quite gratifying, as the animated discussion which ensued indicated pretty clearly that the orientation of the work at present under way at the Research Institute was the right one. The present day trend was to develop tests that would reach the fundamentals of fiber characteristics, and it could safely be said that more work was being done along these lines in Canada than in any other country. Continued development of numerous empirical tests must ultimately lead to excessive complexity and confusion, and it was suggested that there were four basic points regarding fibers a fundamental study of which would undoubtedly tend to simplification if they could be determined definitely; these were: (1) surface appearance, (2) internal appearance, (3) nature of surface, (4) nature of interior.

One member suggested that a need was felt for an instrument that would evaluate the printing qualities of paper; and it was replied that this would be automatically taken care of if the fundamental characteristics of fibers could be known.

Base in Sulphite Pulping

Dr. F. H. Yorston presented a paper, prepared in collaboration with C. R. Mitchell, on the *Role of the Base in Sulphite Pulping.* The lime required in sulphite cooking liquors is determined by the sulphur consumption, and Dr. Yorston suggested that the sulphur consumption was approximately equal to the amount of sulphur present in the liquor in the form of calcium bisulphite. The quantity of sulphur theoretically necessary for sulphonation of the lignin to a degree sufficient for cooking, however, is much less than the actual consumption. A distinction was made between the quantity of lime supplied in the cooking liquor relative to the quantity of wood, and the concentration of lime in the liquor. By carrying out experimental cooks during the course of which the concentration of total and combined sulphur dioxide were maintained substantially constant, it was shown that at a given total sulphur dioxide concentration the rate of cooking and the rate at which carbohydrates are dissolved vary in a systematic manner with variations in the concentration of combined sulphur dioxide. The yield of pulp, and possibly also its strength, are determined by the relative rates of these two processes and not by either alone. Owing to the great differences in the conditions of the experiments and those prevailing in mill operation, the results are not directly applicable to mill conditions.

A Study of Grinding Factors

At last year's meeting Dr. H. Wyatt Johnston drew attention to the very great difficulties encountered in making a thorough and systematic study of all factors involved in grinding by means of the semi-commercial grinder at the Pulp and Paper Research Institute and advised that a miniature grinder was being constructed which would greatly facilitate the work in view. The apparatus is now in use, and Dr. Johnston described what was jokingly called the "vest pocket" grinder, which has a grinding area of 2 square inches. Its actual use is only just starting, so that no definite results can be reported as yet; but the apparatus holds great promise of furnishing exceptionally interesting and valuable results. Dr. Johnston and his co-workers were highly and deservedly commended on the skill and ingenuity displayed in devising the machine.

Education for Paper-Mill Employees

The meeting was brought to a close by the reading of a paper on *Education for the Pulp and Paper Mill Workers* by J. N. Stephenson, editor of *Pulp and Paper Magazine of Canada*, and principal of the Institute of Industrial Arts, in which he showed that it was worth while for the management to encourage

employees to study so as to better fit themselves both for their present positions and for more responsible and better remunerated positions.

Parent Ass'n Elects R. A. McInnis President

At the annual meeting of the parent association, which was held on Friday morning January 31st, R. A. McInnis, general manager and director of Anglo-Canadian Pulp and Paper Mills, was elected president for 1936, succeeding Brigadier-General J. B. White.

◆ ◆

◆ New York College of Forestry Alumni Dinner

The annual dinner of the Pulp and Paper Alumni of the New York State College of Forestry will be held as usual during the week of the annual convention of TAPPI. The dinner will take place at the Sacher Restaurant, 301 Madison Avenue, New York City.

As was the case last year, there will be no formal speeches or program and the meeting will be in the nature of an informal get-together and a renewal of old friendships.

Wm. R. Willets ('25) is chairman of the committee on arrangements. Mr. Willets may be addressed care of the Paper Development Laboratory, Titanium Pigment Co., Inc., 105 York St., Brooklyn, N. Y.

◆ Pagenstecher Leaves Nekoosa-Edwards

Announcement is made of the resignation of Felix Pagenstecher as vice president in charge of sales for the Nekoosa-Edwards Paper Co., Port Edwards, Wis. Mr. Pagenstecher has been connected with the company in this capacity for the past two years. He states that his future plans are not yet ready for announcement. Prior to coming to Nekoosa-Edwards, Mr. Pagenstecher was president of the Bryant Paper Company, Kalamazoo, Mich., and is well known in the industry throughout the Middle West and the West.

John E. Alexander, president and general manager of the company, has announced that Adam Remly, who came to Port Edwards about four months ago as assistant sales manager, will succeed to the position of sales manager. Mr. Remly was for several years vice president and general manager of the Patten Paper Company, Appleton, Wis.

◆ Champion Plans Southern Pulp Mill

The Champion Paper and Fibre Company, Hamilton, Ohio, announces that its stockholders have approved a plan to build a new pulp mill to be located on the Ship Canal about ten miles east of Houston, Texas.

The present plans anticipate the manufacture of bleached and semi-bleached sulphate pulp which will be shipped to the company's paper manufacturing plant at Hamilton, Ohio.

Wm. C. Nash Invents Fourdrinier Tube Roll Arrangement

A NEW invention of William C. Nash, Neenah, Wis., whose long, successful career as a papermaker and inventor of wire and felt guides and other paper machine devices has given him prominent distinction in the paper manufacturing industry, appears to promise an outstanding and important development in the fourdrinier paper machine.

Invitations were issued to a number of machine builders and general managers of the paper industry to attend a demonstration at The Valley Inn, Neenah, Wis., on Saturday, February 1, of a working model of the new invention which has been termed The Nash Flexible Tube Roll Arrangement.

Mr. Nash's new invention has been specifically directed to reduce the speed of the table rolls on the fourdrinier by making them independent of the speed of the wire screen. The arrangement provides that the axes of the tube rolls may be moved at any desired rectilinear speed in the same direction of travel as the wire. Hence, if the axes of the rolls and the wire travel at identical speeds, the tube rolls do not rotate. If a difference is effected in their rate of traveling speed, such as to make the axes move slower or faster than the wire, then the rolls rotate either clockwise or counterclockwise at peripheral speeds to compensate for this difference in rectilinear speed.

Pressure and vacuum at the rolls are thereby prevented or controlled, and a better formation of the sheet is anticipated at a greater speed. Better retention of filler and more uniform sheet surface on both sides, with less wire marks and pin holes, are other results expected by the use of this arrangement.

The demonstration also included the operation of a combined Automatic Stretch and Guide Roll, intended to relieve the strain on the wire cloth. By its unique arrangement, this Automatic Stretch and Guide Roll eliminates the conventional guide roll. Thus, by elevating the couch roll to the same plane as the tube rolls, four or five feet more of wet end are available, either for additional tube rolls or suction boxes with no increase in wire length.

Another demonstration witnessed by those present was the operation of an Automatic Electric Web Guide for rewinders and slitters to keep the paper web in alignment and to control the trim.

Both the Automatic Stretch and Guide Roll and the Automatic Electric Web Guide, which are new in design, are manufactured and sold by Gilbert & Nash Company, Menasha, Wis.

Another interesting feature of the Gilbert & Nash exhibit was the illustration of a new, improved type of Vertical Felt Guide, designed to allow narrower clothing to be used on the machine and keep it in perfect alignment. The old type of Gilbert & Nash horizontal Felt and Wire Guide with a different palm suspension to increase sensitivity and lessen the wear on clothing was also exhibited.

A reorganization of the Gilbert & Nash Company recently has been effected. New officers are: Theodore M. Gilbert, president; George Gilbert, first vice president; William M. Nash, second vice president; and Mrs. James W. Jones, secretary-treasurer.

◆ Maine Dinner During Paper Week

University of Maine men active or associated with the Pulp and Paper Industry have announced that their 6th annual dinner and get-together will be held at the Hotel Shelton, Lexington Avenue and 49th Street on Wednesday evening, February 19th.

These informal dinners are always anticipated by Maine men who attend the annual meetings of the American Paper and Pulp Association and the Technical Association.

Reservations for the dinner may be made by notifying Arno W. Nickerson, 501 Fifth Ave., New York City.

◆ EDW. F. HERRLINGER, president of The Gummed Products Company, Troy, Ohio, retires to Chairman of the Board after twenty-one years of active service. He is succeeded by his son, Roth F. Herrlinger who takes over his new responsibilities after serving the company in the capacity of vice-president. Paul Herrlinger, another son, is promoted from secretary to vice-president, while G. C. Thornburg becomes secretary. Fred L. Holt remains the treasurer of the company.

◆ Appoints Committees for 1936 Supts. Convention

F. L. Zellers, general chairman of the 1936 convention of the American Pulp and Paper Mill Superintendents Association has announced the appointment of his subcommittee chairmen.

The convention will be held June 24, 25 and 26 at the Hotel Pantlind, Grand Rapids, Mich. The following chairmen have been appointed:

Program and Papers—A. L. Sherwood, Sutherland Paper Co.

Mill Visits—J. A. Wise, Kalamazoo Paper Co.

Finance—F. G. French, French Paper Co.

Registration and Exhibits—Dan Stacy, American Box Board Co.

Transportation—O. F. Fischer, Bryant Paper Co.

Sports—C. F. Sisson, Mac Sim Bar Paper Co.

Ladies Entertainment—Mrs. Paul Fortier.

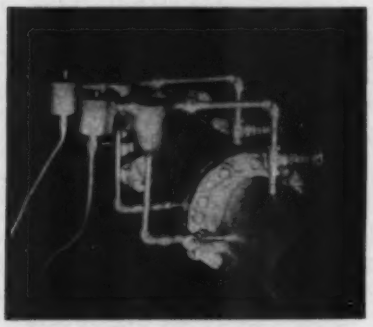
Entertainment—Francis D. Bowman, Carborundum Corp.

Publicity—Joe L. Hodgins, *The Paper Mill.*

Executive Secretary—S. R. Atkinson, Niles, Mich.

◆ Steam Purifier for Steam Meter

The Reaco Company, 146 West Mound Street, Circleville, Ohio, has developed a steam purifier for use with saturated steam meters. This purifier, designated as Reaco, is made for any desirable pressure, for any size of steam pipe where orifice or venturi is installed, and for any make of meter body. The purifier



is installed between the meter and the main steam line — the steam entering unit being purified through a decrease in its velocity and through its impingement against a baffle. The mud and water from the steam flows back into main steam pipe while the purified steam is piped to meter.

◆ Mercury-Incandescent Lighting Unit

A self-contained lighting unit, with color characteristics said to approach actual daylight more closely than any commercial light source heretofore available, has been announced by the General Electric Vapor Lamp Company, Hoboken, N. J. The unit, known as the circular mercury-incandescent, combines, as regularly equipped, a 33-inch circular mercury vapor tube and a 200-watt incandescent lamp beneath one reflector.

The auxiliary for operating the mercury vapor tube is contained within the light unit itself which is installed and connected to the line in the same manner as the ordinary unit for incandescent light.

Both lamp and vapor tube are easily removed for cleaning, and the design and finish of the unit otherwise facilitate cleaning and other maintenance operations.

The unit operates at 500 watts, the high blue and green emission characteristics of the mercury vapor tube blending with the excess red emission common to incandescent lamps in proportions which make for optimum visual characteristics wherever accurate color perception is an important consideration. The over-all cost of this lighting is said to compare favorably with other light sources lacking its exceptional color characteristics.

◆ Forged Steel Valve

A newly improved line of forged steel globe valves has been announced by the Hancock Valve Division of Consolidated Ashcroft Hancock Company, Inc., Bridgeport, Conn. These valves, designed with a tongue-and-groove bolted bonnet for high temperature service and for pressure ratings up to 1500 pounds, are made in either cone or plug type with the valve seat ring and disc of heat-treated stainless steel. This trim material is said to be exceptionally hard and to resist wire drawing, indenting and galling. Among the features cited for

the valve by the manufacturer are: all parts made of steel for safety against fire hazard; long condensation chamber protects and increases life of packing; all wearing parts renewable; seat ring easily removed with standard hex wrench; and easy to repack in service.

◆ Air-Operated Indicator-Controller

The Bailey Meter Company, Cleveland, Ohio, has developed an indicator-controller for pressure and temperature control applications not requiring a record of the factor under control which may operate either a diaphragm motor valve or an air-operated control drive. It incorporates an indicating pointer and scale graduated to measure the factor under control. A second pointer indicates the standard for which the controller is set so that the two pointers coincide when the controller is in operation. The standard setting may be changed to any desired point by turning a knurled knob located under the indicating dial. An adjustment is also provided whereby the sensitivity or control range may be varied from 1 to 1000 per cent of the measuring range.

A Bourdon tube type pressure spring actuates both the indicating pointer and

a free floating air pilot valve. Inlet and outlet air pressures to this pilot are indicated by small gauges on either side of the main indicating dial and connections for air supply and control pressure are made with ¼ in. O. D. copper tubing through the rear of the casing in which the controller is housed. The casing is 13 in. in diameter and may be mounted either flush on a panel or on a wall or column.

◆ Acoustic Communication Booth

A new type of telephone booth, built on the principle of absorbing extraneous sounds rather than blocking them, has

been designed by the Acoustic Division of the Burgess Battery Company, Madison, Wis.

The interior of this booth is faced with a perforated metal sheet backed

with balsam wool. No door is utilized. Neither are there any windows. The booth also is opened around the base.

A shelf supports the telephone instrument, and illumination is provided by an electric light in the ceiling of the booth and also by light which enters the unobstructed front opening.

It is stated that extraneous noises such as originate in a noisy industrial plant are instantly absorbed by this booth, producing within the booth a space of comparative silence that permits conversations to be easily maintained in places where speech would otherwise be impossible.

◆ Heavy Duty Brake Lining

A woven and compressed brake lining, designated as Style 900, is being offered by John-Manville Corporation, 22 East 40th Street, New York, N. Y., for general use on all kinds of heavy industrial equipment. The outstanding feature claimed for the lining is that it cannot ply separate in high temperature service. Among the other features mentioned for it are low rate of wear; efficient friction characteristics; flexibility; adaptability to various speed requirements; mechanical strength; and ability to withstand severe shock-loading.

◆ Overhead Crane Safety Limit Stop

An improved design of limit stop for use in preventing overhoisting accidents on overhead traveling cranes and other applications where positive protection against overtravel is essential has been announced by The Electric Controller & Mfg. Company, 2735 E. 79th St., Cleveland, Ohio. This device, known as the

Improved Youngstown Safety Limit Stop, is of the main motor circuit type, handling motor currents directly without the aid of additional equipment. When the limit stop is tripped, it disconnects the motor from the power line and brings the motor to rest with minimum drift.

The use of needle-type roller bearings and a new heavier gauge, gasketed cover which is bolted down against shoulders on the enclosing case are improvements cited by the manufacturer for this design.

◆ Automatic Motor Base

A motor base designed to maintain uniform belt tension and designated as the Straitline Automatic Ball Bearing Motor Base has been announced by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., for use in connection with its Vari-Pitch Texrope sheave. Four ball bearings, totally enclosed and

lubricated for the life of the unit, support the motor and the upper half of the base. The travel of the base is in a straight line and is always securely anchored to its foundation. A handwheel on the base controls the speed of the Vari-Pitch sheave and simultaneously moves the motor a sufficient amount to compensate for change in centers between shafts resulting from the variation in the diameter of the Vari-Pitch sheave. Then, too, a dial indicator on the base enables the operator to maintain uniform belt tension throughout the speed range adjustment of the base.

◆ Furnace Draft Controller

A complete self-contained furnace draft controller requiring only a draft connection to the furnace and a supply of compressed air at approximately 35 lbs. pressure has been developed by Bailey Meter Company, Cleveland, Ohio.

This controller measures furnace draft with a large sensitive diaphragm, the movement of which actuates an air pilot valve admitting pressure to one end or the other of a drive cylinder until the damper position or fan speed has been changed sufficiently to restore furnace draft to the desired value.

The controller, functioning independently of other control equipment, may be applied either to the forced draft or the uptake draft as desired.

◆ Metal-Clad Switchgear for Light Duty Service

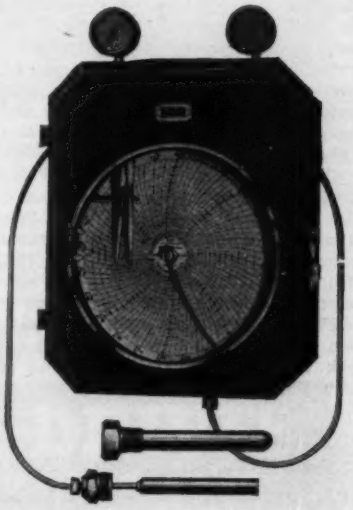
The General Electric Company, Schenectady, N. Y., has announced that its line of metal-clad switchgear (Type MI-9) has been extended to light duty service for a wide range of applications in industrial plants, central stations, and elsewhere.

Each metal-clad unit includes an oil-blast circuit breaker, instrument transformers, disconnecting devices, supporting structure, interlocking equipment, self-contained elevating mechanism with a removable lever, bus and interconnections. The oil-blast circuit breaker (Type FK-42) with its operating mechanism forms a removable element which can be lowered by means of the elevating mechanism and then withdrawn from its housing. This breaker, which may be operated manually or electrically, is employed in either of two ratings—600 amperes and 5000 volts or 800 amperes and 2500 volts, both with an interrupting rating of 25,000 kv-a.

Ease of installation, economy, safety to attendants and reliability and continuity of service are among the advantages cited by the manufacturer for this switchgear.

◆ New Separable Well Tube System

The Taylor Instrument Companies, Rochester, N. Y., have developed a separable well tube system, known as the "Thermospeed," for use with their thermometers and controllers, that is claimed to have a speed response approaching that of their extremely fast bare bulb systems. Tests are stated to indicate a response approximately six times faster than the average separable well tube system now in service and al-



most twice as fast as separable well thermocouples. Complete details of the system will be supplied by the manufacturer upon request.

◆ Fluid Proportioning Machines

The introduction and development of three new proportioning machines has been announced by the D. W. Haering & Company, Inc., 3408 Monroe St., Chicago. These machines employ the direct transmission of pressure differentials from pitot tubes and utilize liquids as fluid pistons. One of the machines, a corrosive solution feeder, provides a sight feed indicator, thus making it possible to count the number of drops of such

solutions as hypochlorite that are being fed per minute. Another machine represents a new application of the fluid piston principle; while the third machine employs the direct transmission of pressure differentials from pitot tubes in a single compartment unit in which there are no pistons or diaphragms and in which it is claimed to be impossible for dilution of the reagent to occur.

◆ Graustein Quits I. P. Co. Cullen Made President

Announcement was made February 4 of the resignation of A. R. Graustein as president and director of the International Paper Company and the International Paper and Power Corporation. R. J. Cullen has been appointed to succeed Mr. Graustein as president of the International Paper Company.

Mr. Cullen has for some time been president of the Southern Kraft Corporation, a subsidiary of the International Paper and Power Corporation.

◆ Cyanamid Group Acquires Services of Dr. Shepard

Dr. Norman A. Shepard has been appointed Director of Technical Service for the American Cyanamid Company, the American Cyanamid & Chemical Corporation and other companies in the Cyanamid group where co-operation in this field is required. He will be responsible for directing the technical service laboratories located in Stamford, Connecticut, the expansion of the sales service laboratories to meet present and increasing need and the co-ordination of the technical and sales service work in all of the several divisions of the above named companies.

Dr. Shepard is a graduate of Yale University (Ph.D.1913), was Assistant Professor of Chemistry at Yale University from 1917 to 1919 and has been director of the research laboratories of the Firestone Tire and Rubber Company from 1919 to date. He will begin his work with the Cyanamid group on or about February 15th.

◆ Madison Man Gets Post in Forest Service

F. A. Silcox, Chief of the U. S. Forest Service, has announced the promotion of George W. Trayer, Madison, from a position as senior engineer on the staff of the Forest Products Laboratory here to the position of chief of the division of forest products in the U. S. Forest Service, Washington, D. C. The position, newly established by the Forest Service head, involves liaison activities designed to integrate wood utilization research with other federal forestry activities throughout the United States. Mr. Trayer's headquarters will be in Washington.

The elevation of Mr. Trayer to his new post is part of a reorganization of the Forest Service by Chief Forester Silcox to facilitate the handling of additional responsibilities involved in emergency conservation activities and is in line with plans to recruit specially qualified men from the ranks of the Forest Service for important administrative assignments.

◆ Handling Paper Bales in Board Mill

The installation of a 500-lb. electric hoist, a short 1-beam section and a bale grab in a paperboard and box making plant has simplified the handling of paper bales, has decreased the cost of this handling, and has minimized the possibility of strains on the part of the bale handlers.

The bales that are being handled are produced from the cuttings of the box plant. They weigh approximately 300 pounds each and individually are 4 feet

long, 2 feet wide and 18 inches high. These bales discharge from the baler about 4 inches above the floor.

Previous to the installation of the overhead system, two bale press operators—one to feed the stock and the other to set the wires and to control operation — were required to roll the bales from their discharge position upon lift truck platforms to permit them to be transported a distance of 900 feet to waste paper storage.

These platforms held three bales each as the weight of the bales did not permit the operators to tier them. Since the installation of the simple overhead system with grab hook the bales are tiered three high on the platforms, thus making one trip to storage take the place of three.

This procedure not only cut down battery consumption, but also saved two-thirds of the operator's time for other work. In addition, the output of the baler has been increased 25 per cent, because one man can lift the bales upon the platforms with little effort, the second man not being required to leave the baler at any time.

The total investment for this bale handling system was less than $500, an investment that is paying for itself at least twice a year.

◆ M. H. Waterbury

M. H. Waterbury, treasurer of H. Waterbury & Sons Company, felt manufacturers of Oriskany, N. Y., passed away suddenly at his home January 11, at the age of 60 years.

Mr. Waterbury was born at Rensselaerville, N. Y., September 23, 1935. His life work was in the organization of H. Waterbury & Sons Company, he having been treasurer of the company for the past thirty years.

Mr. Waterbury leaves his widow, two daughters and a son, Mark H. Waterbury, Jr., who is assistant superintendent of the H. Waterbury & Sons Company. Besides his immediate family, the deceased is survived by two brothers, J. E. Waterbury, president of H. Waterbury & Sons Company, and C. H. Waterbury, vice president, and two sisters, Mrs. Amy W. Safford, of South Dartmouth, Mass., and Mrs. Nicholas A. Walbran, of Oriskany.

◆ Paper Converting Perfects New Tissue Machine

The Paper Converting Machine Co., Green Bay, Wis., manufacturers of paper converting machinery, have just completed and installed a machine for making hard wound embossed toilet paper rolls. Operations are all on one machine, and little, if any, embossing is taken from the sheet in the winding operation.

It makes a very compact roll, the 1000 sheet roll being from 4½ inches to 4¾ inches in diameter. This is considered a compact roll when compared to the soft wound embossed roll that is much larger in diameter.

◆ H. W. Butterworth, Jr. Heads Company

At a meeting of the stockholders of H. W. Butterworth & Sons Company, Philadelphia, held Monday, January 20, Harry W. Butterworth, Jr., was elected president of the company to succeed his uncle, the late Albert W. Butterworth.

The Board also elected Harry W. Butterworth Sr., head of the board; J. Elbert Butterworth, executive vice president and treasurer; Henry W. Butterworth, vice president; and James Butterworth II, secretary and assistant treasurer. The aforementioned officers and J. Warner Butterworth comprise the directorate.

◆ T. L. Wheeler Now V. P. of Arthur D. Little, Inc.

Arthur D. Little, Inc., chemists and engineers of Cambridge, Mass., announced February 1, the election of Thorne L. Wheeler as vice president. Mr. Wheeler graduated from Yale in 1909 and from Massachusetts Institute of Technology in 1911. Following graduation he went with the Southern Cotton Oil Company as chemist and had become Works Superintendent at the time of the War, when he served in the Chemical Warfare Service as major in

the Technical Development Department on the large scale development of charcoal and soda lime manufacture for gas masks. He then became partner with Wheeler and Woodruff, Consulting Chemical Engineers, joining Arthur D. Little, Inc,, in 1925.

The company also announced the reelection of Karl P. Stevenson, president; Raymond Stevens, vice president; Alexander Whiteside, secretary, and Roger C. Griffin, treasurer.

◆ Merle P. Chaplin Announces Chaplin Corporation

Merle P. Chaplin announces the establishment of Chaplin Corporation, located at Portland, Maine. Under this name, Mr. Chaplin and associates offer an industrial development and engineering service for special pulp and paper products.

Mr. Chaplin was formerly connected with the Keyes Fibre Company, Waterville, Maine, as chief engineer. Most of his work for the past twenty years has been along the lines of special development and much of it has had to do with the treatment of pulp and paper fibres and with the molding of articles from these materials. Mr. Chaplin has devoted much time and study to all phases of pulp moulding and has patented something over fifty articles, machines and processes. Under the newly formed Chaplin Corporation, this work will be continued, as well as other special development, consulting engineering and patent work.

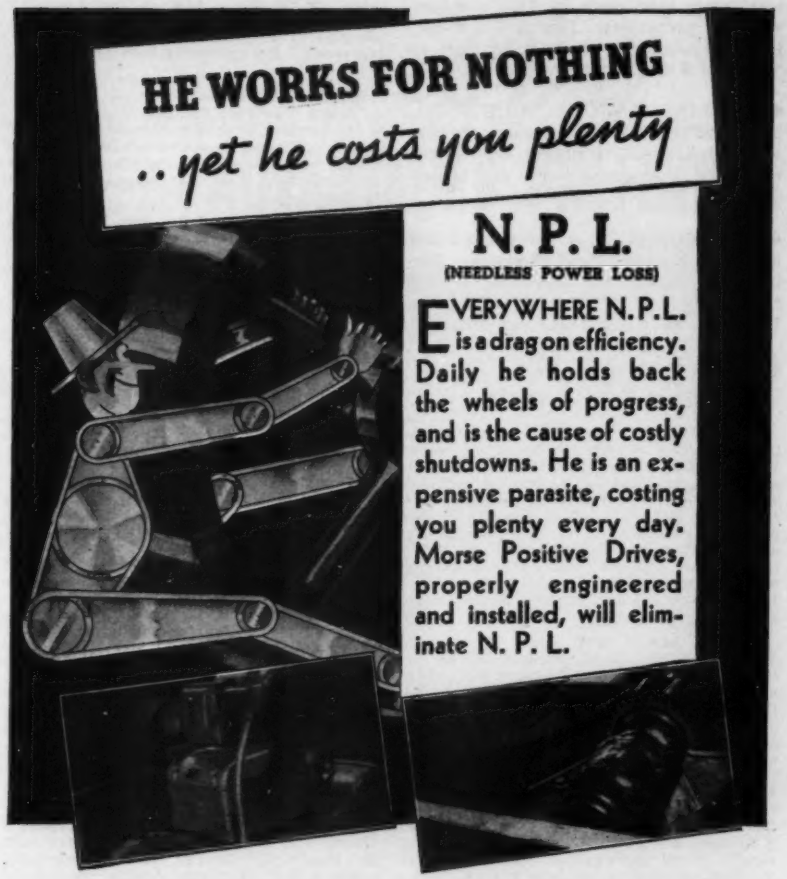
◆ BAUER BROS. COMPANY, Springfield, Ohio, manufacturer of the Bauer refiner, announces the appointment of Arthur S. Cosler as sales manager. Mr. Cosler is well known to many of the mills in the States and Canada, and in his new connection will be pleased to contact his old acquaintances who may be customers of the Bauer Company or interested in its products.

◆ Geo. Robertson Joins Midland Engineering

The Midland Engineering & Appraisal Co., with offices at 205 W. Wacker Drive, Chicago, has secured the services of Mr. George Robertson, who will give special attention to paper mill service.

The Midland company is headed by E. B. Fallon, who was formerly connected with the Bodeaux Company and the American Appraisal Company of Milwaukee. As engineers and appraisers, the company specializes in plant layouts, industrial reports, cost reduction, engineering and appraisal service.

Mr. Robertson has been in paper mill work for many years, both in this country and abroad. During the past twenty years he has been connected with such companies as the American Writing Paper Company, International Paper Company, and has handled several large jobs for the Gotheals organization and the Sherman Corporation in industrial engineering lines.


HE WORKS FOR NOTHING
..yet he costs you plenty
N. P. L.
(NEEDLESS POWER LOSS)
EVERYWHERE N.P.L. is a drag on efficiency. Daily he holds back the wheels of progress, and is the cause of costly shutdowns. He is an expensive parasite, costing you plenty every day. Morse Positive Drives, properly engineered and installed, will eliminate N. P. L.
FOR STEADY, POSITIVE OPERATION
Morse chain drives are dependable, transfer power continuously, conserve power, increase machine output and at the same time reduce power and transmission costs. Short centers permitted by chain drives save production space, provide better lighting and operating conditions. Unless you are using chain drives, you are wasting power. Ask for more information.
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◆ Bantam Company Supplies Bearings for Cape Cod Bridge

The application of roller bearing pillow blocks on the main sheave axles of the new vertical lift railways bridge over the Cape Cod Canal at Buzzards Bay, Mass., has caused some of the country's leading bridge builders to comment on the advancement made in bridge engineering due to using anti-friction bearings for a bridge of such size. The roller bearings used in the construction of this bridge were supplied by the Bantam Roller Bearing Co., South Bend, Ind.

The railway bridge, together with two new high level bridges for wheeled traffic, have been constructed in the first steps taken by the Federal Government in reconstructing the Cape Cod Canal along modern water transportation lines.

◆ THE DYESTUFFS DIVISION of E. I. du Pont de Nemours & Company, Inc. announces the development of "Lithosol" Fast Green B Paste, (Patent applied for) which produces yellow shades of green, as an addition to its line of lake colors. It is of interest as a pigment for wallpaper printing as it passes the twenty-four-hour FadeOmeter test for wallpaper light fastness, and it is used as a pigment in printing inks. It is also claimed that "Lithosol" Fast Green B Paste can be recommended for use in the beater or as a coating product,

combining good fastness with excellent working properties. Lithosol is a registered trade-mark of E. I. du Pont de Nemours & Company, Inc.

◆ COLLINS MANUFACTURING CO., North Wilbraham, Mass., announces that Howard A. Casey, formerly sales solicitor of the Hampshire Paper Co., is now connected with the Collins company.

◆ A. P. NUTTER has severed his connection with the Brown Company, Berlin, N. H., to become associated, according to report, with the Upson Company, Lockport, N. Y., as works engineer.

◆ New Catalogues and Publications

Alemite Corp., 1678 Diversey Pkwy., Chicago—The Alemite Div. of Stewart-Warner Corp., has just released a new industrial lubrication reference manual. This book contains lubricant recommendations for all types of industrial plants classified according to types of machinery and according to types of gears and bearings. The editorial content includes a number of articles on lubrication subjects. There are a number of illustrations and diagrams.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—New literature recently issued by this company includes: Bulletin No. 2188A which includes its completely extended line of Duro Brace Texsteel Sheaves for stock drives up to 15 hp. Informative data and tables are included. Other bulletins are four new illustrated leaflets on centrifugal pumps as follows: No. 2206, Large low head double suction single stage Type S pumps; No. 2207, Large high head double suction single stage Type S pumps; No. 2208, Small double suction single stage pumps; No. 2210, Type M Multi-stage double suction pumps.

Beaver Pipe Tools, Inc., Warren, Ohio—A recent folder describes and illustrates this company's new Model "A" Special Pipe Machine, which has a capacity ⅛ to 2 inches. This is a companion tool to the Model "A" Standard. The outstanding features of this machine are fully but concisely covered in the folder. There are prices and other interesting information as well as illustrations.

Benjamin Electric Mfg. Co., Des Plaines, Ill.—A new 28-page bulletin gives complete data on the new 400 watt High Intensity Mercury Vapor Lamp—how it operates, its color composition and its advantages—for various types of interior and exterior illumination. It gives complete description, illustrations, dimensions and list prices on Benjamin lighting fixtures for the High Intensity Mercury Vapor Lamp, with tables on illumination, calculations applying to the various fixtures, and outlines a method of designing a general lighting system with these fixtures including design of a combination lighting system consisting of mercury vapor and incandescent lamps. Copies on request.

Cochrane Corp., Philadelphia, Pa.—This company, together with the co-operation of the Hays Corporation and the Carrick Engineering Co., both of Michigan City, Ind., are offering industrial users an advanced system of measuring and control equipment for boiler operation. This line, known as the Hays-Carrick-Cochrane boiler instruments are featured in a new publication No. 2246, which may be obtained from any one of the three companies.

Geigy Company, Inc., 89-91 Barclay St., New York City—This manufacturer of aniline colors, extracts, etc., has just released some new and very attractive color charts. One folder, No. 261-D, illustrates 16 sample shades recommended for clay and mica coated papers. Dyeing instructions are shown. Also, a board binder holds an accordion folded color chart with samples of 48 shades for unbleached paper stock. Recommendations for use are given.

General Electric Co., Schenectady, N. Y.—"Steam Turbines for Mechanical Drive" is the subject of a new catalogue just released. The catalogue is profusely illustrated and one section is devoted to the application of the turbine-gear unit for driving a paper machine.

Grasselli Chemical Co., Inc., 629 Euclid Ave., Cleveland, O.—"Chromated Zinc Chloride—an Improved Wood Preservative" is the subject of a recent booklet just received. The text takes up such subjects as the value of Zinc Chloride as a wood preservative, experimental data on preservative value, corrosion, termites, paintability, fire retardance, and the fabrication of lumber. This booklet is nicely printed with an attractive varnish-treated cover in color.

International Nickel Co., Inc., 67 Wall Street, New York City—Paper mill executives will be interested in Bulletin C-3 just released by this company entitled "Monel Metal in Pulp and Paper Mills." This bulletin describes the advantages of Monel Metal and nickel in applications where these metals have found general acceptance in the treatment of stock after pulping, in paper machines, caustic recovery and pumps. It gives service records reported by a variety of mills. Data are included on the engineering properties of Monel Metal, nickel and nickel-clad steel. Also the bulletin gives the properties of K Monel, "H" Monel Metal and "S" Monel Metal which are new products having exceptional mechanical properties as well as the corrosion resistance of regular Monel Metal. The bulletin is profusely illustrated.

Lawrence Machine & Pump Corp., 371 Market St., Lawrence, Mass.—A new bulletin, No. 207, describes this company's slurry and sludge pumps which are said by the manufacturer to be especially adapted for pumping liquids containing abrasive solids in suspension such as cement slurry, tailings in ore reduction plants, milk-of-lime, etc. The bulletin describes the construction and application of this type of pump, and includes some interesting cuts and a table of sizes and capacities.

Linde Air Products Co., New York City—A booklet just issued is a consolidation and orderly arrangement of the known facts regarding the repair of damaged cast iron machinery by the oxy-acetylene process. The booklet discusses the applications for which the respective processes of bronze-welding and fusion welding are best suited. How the composition, the physical properties, and the intended use of the casting respectively influence heat control methods and the choice of welding procedure are considered.

Montague Machine Co., Turners Falls, Mass.—A new bulletin has just been issued featuring this company's new Waterous flat screen, the operation of which is described by them as "Screening with Piston-Stroke Precision." The features of construction of this screen are given, and the simplicity of its design and its smooth and quiet operation explained. The bulletin is illustrated with pictures of the screen and a line drawing. Copies upon request.

Paper and Industrial Appliances, Inc., 122 E. 42nd St., New York City—An interesting pictorial data sheet in broadside form has just been published by this company. This data sheet describes and illustrates the features of the Thorsen-Hery Beater. It contains comparative beater performance charts; tables giving comparative beater performances based on power dollars; photomicroscopic views showing results of beater treatments of stocks; sketches of the most effective method of stock pickup and treatment; descriptive illustration of a quick method of preparing high-density stocks, and other valuable information of interest to mill men. Copies will be sent to mill men upon request.

Policyholders Service Bureau, One Madison Ave., New York City—"Training Supervisors and Key Men" is the subject of a publication just released which is a report of a survey conducted by the Metropolitan Life Insurance Co. This report presents an outline of the practices of 85 companies that have inaugurated a program of training such supervisors as foremen and the other non-commissioned officers of managerial staffs. Methods of training discussed in the report vary from the studied informality of the "conference" method to schedules of lectures on such subjects as economics, psychology, time study and cost accounting, also on company organization and history, products and markets, plant policies and practices. Copies are available on request.

Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin EJ-1905 is a revised and enlarged edition of catalogue featuring the Yarway Expansion Joints. In addition to the descriptive text, there are tables of data and illustrations of typical installations. Many of the illustrations are color plates.

BOOKS

Modern Bookbinding—This publication, the fifth of the J. M. Dent Memorial Lectures, is a pocket-size monograph of 63 pages that surveys the development of modern bookbinding and describes methods, processes, and materials of today. Douglas Leighton is its author. The publisher is Oxford University Press, 114 Fifth Avenue, New York City.

Phillips' Paper Trade Directory of the World—The 1936 edition of this well-known directory is now on the market. It is a book of over 800 pages that not only gives the names, addresses, and capacities of the paper mills of the world, but also includes information on the paper trade customs of Great Britain, America, France, and Germany. General trade rules adopted by the Swedish, Norwegian and Finnish Paper-Makers' Association and numerous other specific data are also given. Among this data, arranged by sections and containing a wealth of information for any one interested in the trade, is a glossary of trade terms. This glossary lists a large number of the trade terms in English and then gives the French, German, Spanish, Italian and Swedish equivalent for each of them. This glossary alone should prove invaluable to any one who frequently or infrequently has to deal with foreign literature of the trade or with the trade itself. The book, published by S. C. Phillips & Company, 47, Cannon Street, E. C. 4, London, England, may be obtained direct from the publishers for one guinea per copy.

Power Plant Chemistry—This book constitutes in revised and enlarged form the fourth edition of the publication previously known as "Engine Room Chemistry." The book written by Augustus H. Gill, formerly Professor of Technical Analysis of the Massachusetts Institute of Technology, treats the fundamentals of engine room chemistry in a simple and practical manner. It covers the origin, production and various uses of fuel, water and lubricants and describes simple and inexpensive methods of testing these substances. Among the specific subjects treated in individual chapters are fuels and their analysis, regulation of combustion—gas analysis, boiler scale—pitting and corrosion, mineral oils, and animal and vegetable oils and greases. In addition to a number of reading references the book also includes a number of salient tables. It is a book that should prove of interest and helpfulness to power plant engineers and operators. The price is $2.50 per copy, and the publishers are McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y.

◆ Additional Subjects Announced for T.A.P.P.I. Meeting

A distinguishing feature of the meetings of the Technical Association of the Pulp and Paper Industry scheduled for February 17 to 20 at the Waldorf-Astoria Hotel, New York City, is the stress that is placed on the fundamentals underlying pulp and paper manufacture. It is the feeling of those in charge of the program that in addition to the exchange of information relating to the more common operating practices it is necessary to consider just why processes act the way they do. Knowing these principles, it is possible to do things in a more satisfactory and economical way. Since fundamental knowledge can be obtained only as the result of research by competent investigators, the Technical Association is fortunate to have within its membership the majority of those related in the industry or related to it, who are capable of making worthwhile contributions to manufacturing progress.

One of the outstanding speakers on the program is Dr. Walter M. Fuchs, eminent former Austrian chemist, who will speak on the subject "Preparation and Constitution of Lignin." Dr. Fuchs is at present associate research professor in the School of Mineral Industries, Pennsylvania State College, with which he has but recently become associated. He is a graduate of the University of Vienna. Dr. Fuchs has presented more than 100 technical papers and written five books, and is considered an authority on coal and lignin.

In addition to the program published in the January issue of THE PAPER INDUSTRY, the following subjects have been announced:

The Chemical Nature of Dyestuffs in Pine Woodpulps, by Glen M. Huettet, M. W. Bray and C. E. Curran.

The Effect of pH on the Rate of Chlorine Consumption in Bleaching, by W. O. Hisey and C. M. Koon.

Study of Tensile and Bursting Tests for Paper, by R. C. Griffin and R. W. McKinley, of A. D. Little, Inc.

A Study of Some Variables in the Sheet Making Operation, by F. C. Peterson and F. G. Barber, New York State College of Forestry.

T.A.P.P.I. Medal Awarded to W. H. Millspaugh

The Executive Committee of the Technical Association of the Pulp and Paper Industry is pleased to announce that in accordance with the provisions of the Articles of Organization of the Association, it has unanimously voted to award its fifth Gold Medal to William H. Millspaugh, a T.A.P.P.I. member and President of Centrifugal Steel, Inc., Sandusky, Ohio, and Millspaugh, Ltd., Sheffield, England.

When Mr. Millspaugh applied for membership in the Association in 1916, he indicated his qualifications as a designer, inventor, salesman and manufacturer of hydraulic and paper machinery covering a period of 23 years.

He is probably best known as an inventor of the suction roll and its application to the paper machine. For many years he was president of the Paper and Textile Machinery Company, Sandusky, Ohio.

The official presentation of the medal will be made by W. G. MacNaughton.

Although Mr. Millspaugh now spends most of his time in England, he has arranged to be present at the T.A.P.P.I. luncheon on Thursday, February 20, in the Grand Ballroom of the Waldorf-Astoria Hotel, New York, to receive the medal.

◆ Meetings of Interest to Cost and Production Executives

During the annual convention of the American Paper and Pulp Association at the Waldorf-Astoria, there will be held two important meetings in connection with the Association's Comparative Reporting Service on operating efficiencies and costs.

The first meeting on Tuesday, February 18, at 3:00 p. m., will be entirely devoted to a presentation of the management aspects of this service by a group of well-known executives. The various features of the service will be discussed at the morning meeting on Wednesday, February 19, at 10:00 a. m., followed by a buffet lunch; and at 2:30 p. m. there will be a committee meeting to discuss developments of the service.

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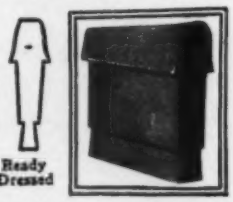

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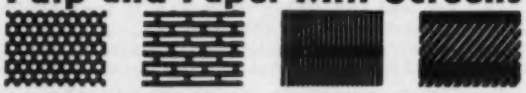

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interested are cordially invited to attend these meetings. The subjects of discussion should prove of particular interest to those actively engaged not only in the management of paper and pulp mills, but also in cost work and production efficiencies.

◆ Westinghouse Celebrates Golden Anniversary

In January, 1886, in a little shop in Garrison Alley, Pittsburgh, Pa., George Westinghouse founded a company which has grown into a world-wide organization. This year, the Westinghouse Electric & Manufacturing Company, with its vast holdings and long list of achievements, celebrates the golden anniversary of its existence—a half century of progress in practically all phases of electrical manufacturing.

The following chronology records some of the important events in the history of the company's engineering developments:

1886—Charter granted to Westinghouse Electric Company January 8.

Transformer successfully developed, making possible the whole alternating current system.

First a-c. generating station put into operation, Buffalo, N. Y.

1887—Introduced the "Toothed Core" armature. This design has been used for all subsequent rotating electrical machinery.

1888—Built the first meter for measuring alternating current.

Introduced the first line drop volt-meter compensator.

Acquired the Tesla patents for alternating current induction motors.

1889—Introduced the Stillwell a-c. feeder voltage regulator.

1891—Installed the first long distance alternating current power transmission line at Telluride, Colo.

1892—Produced the polyphase system of a-c. generation and distribution.

1893—Lighted the World Columbian Exposition at Chicago, the greatest display of incandescent lighting in the world up to that time, and exhibited complete polyphase current system for all purposes in full operation.

1894—Produced the first modern type practical polyphase induction motors, thus bridging the way for the substitution of motor power for the driving of industrial machinery.

1895—Installed the first great power plant for the Niagara Falls electrification.

1896—Developed induction motor with squirrel-cage winding.

1899—Introduced the Parsons Steam Turbine and built the first commercial turbine generator units in this country (400 hp.).

1900—Built America's first large turbine generator (2,000 kw.) revolutionizing generation of electricity from coal.

1909—Developed the self-starting synchronous motor.

1910—Developed sectional drive for paper machines using synchronized direct current motors.

1913—Introduced Micarta insulation. This later was adapted to many industrial and decorative uses, such as the Micarta gears, bearings and pulleys, wall panels and the familiar Micarta tray.

1914—First high tension transmission line east of the Mississippi—60,000 volt Niagara Falls to Syracuse, New York.

1916—Developed the oil pressure system for starting large synchronous motors.

1922—Developed the De-ion system of arc control, thus increasing the capacities of circuit interrupting equipment.

1931—Began the extensive use of vacuum tubes in industrial control equipment.

1935—Developed high intensity mercury lighting.

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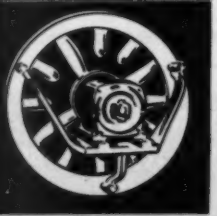

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July 1, 1935 to June 30, 1936

Cumulative Scores as of December 31

25 Perfect Scores

PERFECT SCORES

Division I—Paper and Pulp Mills

	PARTICIPANT	MILL	LOCATION
GROUP A	Hollingsworth & Whitney Co.	Algonquin & Taconnet	Waterville, Me.
GROUP B			
GROUP C	Continental Paper & Bag Corp.	York Haven	Pennsylvania
	Finch, Pruyn & Co., Inc.	Glens Falls	New York
	Crystal Tissue Co.	Middletown	Ohio
	International Paper Co.	Little Island	No. Tonawanda, N. Y.
	Hoberg Paper & Fibre Co.	Fibre Div.	Green Bay, Wis.
	Ontonagon Paper Corp.	Ontonagon	Michigan
GROUP D	Harriman Company	Harriman	Tennessee
	International Paper Co.	Webster	Orono, Maine
	Hollingsworth & Whitney Co.	Arcostook & Cobbossee	Gardiner, Me.
	Bird & Son, Inc.	Phillipsdale	Rhode Island
	U. S. Gypsum Co.	No. Kansas City	Missouri
	Central Fibre Prods. Co.	Vincennes	Indiana
	Spaulding Fibre Co., Inc.	Milton	New Hampshire
	U. S. Gypsum Co.	Gypsum	Ohio
	Hollingsworth & Whitney Co.	Abenaquis	Madison, Me.
	Central Fibre Prods. Co.	Mt. Carmel	Illinois
	International Paper Co.	Riley	Maine
	Mead Paperboard Co.	Rockport	Indiana

Division II—Remanufacturing

	Union Bag & Paper Corp.	Specialty	Hudson Falls, N. Y.
	Kimberly-Clark Corp.	Atlas	Appleton, Wis.
	Container Corp. of America	Natick	Massachusetts
	Texas Corrugated Box Co.	Dallas	Texas
	U. S. Gypsum Co.	Genoa	Ohio
	Bemis Bros. Bag Co.	East Pepperell	Massachusetts

IMPERFECT SCORES

	Key Number	Rank	Disabling Injuries	Frequency Rate
GROUP A	P- 30	2	2	2.195
	P- 44	3	3	3.796
	P-101	4	3	4.112
	P- 67	5	6	5.120
	P- 27	6	11	6.688
	P- 64	7	4	6.799
	P- 78	8	6	7.281
	P- 10	9	6	7.843
	P- 12	10	6	8.368
	P- 1	11	11	9.191
	P- 31	12	6	9.410
	P- 62	13	10	10.039
	P- 18	14	10	10.203
	P- 13	15	10	11.277
	P- 19	16	9	11.553
	P- 99	17	10	11.630
	P- 2	18	9	13.029
	P- 23	19	6	13.903
	P-102	20	17	16.589
	P- 95	21	12	17.133
	P-114	22	21	25.787
	P- 73	23	26	25.857
	P- 87	24	24	30.321
	P- 74	25	32	32.957
	P- 71	26	41	60.801
GROUP B	P- 70	1	1	1.753
	P- 15	2	1	2.089
	P- 46	3	1	2.581
	P- 68	4	2	4.060
	P- 11	5	2	4.457
	P- 22	6	3	6.175
	P- 21	7	4	7.413
	P- 26	8	5	9.009
	P- 82	9	5	9.604
	P- 51	10	4	9.733
	P- 60	11	5	11.453
	P-112	12	6	15.009
	P- 54	13	7	17.138
	P- 3	14	7	17.332
	P- 25	15	12	20.090
	P- 16	16	10	22.718
	P- 40	17	14	23.704
	P- 45	18	14	30.959
	P- 76	19	13	31.725
	P-104	20	12	32.893
	P- 32	21	25	43.397
	P- 77	22	34	56.482

	Key Number	Rank	Disabling Injuries	Frequency Rate
GROUP C	P- 97	7	1	5.132
	P- 59	8	2	5.912
	P- 72	9	3	8.432
	P- 43	10	2	8.926
	P-103	11	2	10.489
	P- 55	12	3	10.615
	P- 6	13	2	11.110
	P- 41	14	4	16.857
	P- 88	15	5	16.933
	P- 37	16	5	16.996
	P- 4	17	6	17.208
	P- 47	18	5	21.233
	P- 75	19	6	21.636
	P- 29	20	6	22.204
	P- 48	21	6	22.953
	P-111	22	6	24.478
	P- 49	23	5	24.563
	P- 34	24	6	26.899
	P- 89	25	8	33.182
	P-107	26	9	47.197
	P- 14	27	10	48.784
	P- 33	28	13	48.848
	P-113	29	20	68.971
	P- 50	30	15	77.942
GROUP D	P- 7	13	1	6.402
	P- 81	14	1	6.624
	P- 53	15	1	9.911
	P-118	16	2	10.465
	P- 65	17	1	16.559
	P- 36	18	2	19.301
	P- 90	19	2	20.681
	P-117	20	3	21.212
	P- 85	21	1	25.478
	P- 94	22	4	29.238
	P- 80	23	6	35.175
	P-116	24	6	36.650
	P- 8	25	3	37.753
	P- 42	26	4	41.173
	P- 98	27	6	43.020
	P-106	28	7	47.853
	P- 24	29	6	54.118
	P- 99	30	4	57.593

Division II

	R-20	7	2	4.032
	R-18	8	1	5.871
	R- 3	9	1	8.010
	R- 1	10	2	9.930
	R- 5	11	5	10.643
	R- 2	12	5	11.685
	R- 6	13	8	13.573
	R-14	14	1	14.419
	R-21	15	7	15.314
	R- 9	16	3	18.044
	R-10	17	10	32.003

No Dec. report: Int. Paper Co., No. Tonawanda, N. Y.; Int. Paper Co., Riley, Me.; Bemis Bro. Bag Co., East Pepperell, Mass.
P-54, P-65, P-99, R-5.

No Nov. and Dec. report: P-33.

Withdrawn: P-79, P-83.

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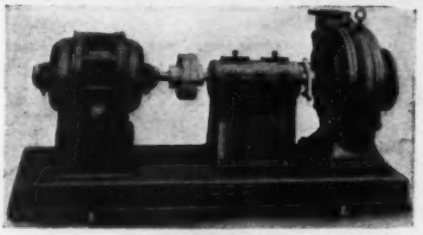

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POWER

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This section turns the searchlight on power and its allied problems, showing big possibilities to save. Opportunities to improve conditions, methods, apparatus will be discovered. Worth while practices suggest new ideas and wider usages of equipment.

By W. S. JOULE

◆ Accident Prevention

Nowhere is the saying "a safe workman is the best safety device" more true than in the operation of a power plant. Surveys extending over a number of years in various industries show conclusively that only 25 to 50 per cent of all industrial accidents can be prevented through mechanical means. That is, the safe-guarding of machinery and equipment can never completely protect the workman and therefore other agencies must be brought into play.

With the above percentages in mind the indictment must be made that from 50 to 75 per cent of all accidents are due to the ignorance or carelessness of those who are injured or their associates. Those injuries which are the direct result of ignorance must be charged up against the management, for it indicates that proper instruction has not been given. This instruction, having been given, however, the responsibility rests with the workman.

Carelessness is as much a frame of mind as it is a bodily habit and it has just begun to dawn upon us what causes that frame of mind and how it can be changed. The installation of mechanical devices alone will not effect the desired result but their combination with educative methods and the bolstering up of morale will result in reducing accidents to the minimum.

Every employe should know that a prequisite to promotion is not only the thorough understanding and constant practice of the safety rules pertaining to his own job, but also an understanding of the safety rules of the job to which he aspires. It is up to the management to initiate the safety movement and then insist upon having the full cooperation of each employe.

◆ Water Level Regulation Effects Economy

Modern practice favors a variation in water level with the load being carried; as the load carried by the boiler increases, the water level lowers; thus, by the slight decrease in steam pressure, due to the increased demand for steam, some of the boiler water is permitted to flash into steam without completely replacing it with feed water until the furnace conditions have had an opportunity to adjust themselves to the new load. With a decrease in load, the rate of feeding is not adjusted immediately to the steam output of the boiler, which permits a rise in water level and the storing of heat in the boiler water which may be called upon in case of a sudden demand for steam. The fluctuation is, of course, always within safe limits of operation.

Such conditions cannot be maintained by hand regulation as the adjustments are too delicate and require too close attention, particularly where the load is of a variable character; the action can, however, be approximated, even with hand regulation. The operator's guide in maintaining water level is the gauge glass supplemented by occasional use of the trycocks on the water column. The column should also be equipped with high and low alarms, particularly when hand regulation is depnded upon.

In the case of fluctuating loads, a sudden demand for more steam causes more violent ebullition, so that the boiler water contains more steam bubbles, consequently its volume increases and, without any change in the rate of feeding, the water level rises. With a decrease in load, the reverse takes place. Hence any automatic regulator which varies the rate of feeding according to the level of the water in the boiler will give opportunity for the furnace conditions to be adjusted to changed load conditions before changing, materially, the amount of water being fed into the boiler. This results in higher economy than would otherwise be the case, as changes in furnace conditions cannot be made rapidly without losses due to improper combustion conditions during the time the changes are taking place.

◆ Instruments Are for Those Who Can Use Them

Once in a while, yes, quite frequently, we visit power plants where modern instruments are installed but some of them are out of commission and remain so indefinitely, with apparently no effort on the part of the engineer to put them into service. Instruments out of service are worse than useless; they are a dead expense and, if out of order, sometimes even dangerous when operators depend upon the readings thinking they are correct. The management which permits such conditions to exist deserves severe criticism. Instruments are either reliable or unreliable, useful or not useful; any engineer may make a mistake in his selection of instruments, but in any event he should either keep them in use or throw them out entirely.

Another class of power plant engineers demand that instruments be kept in perfect order and require the most elaborate system of records kept, yet when the reports are turned in, the records are filed and seldom, if ever, used to better plant conditions. Can anybody imagine why a power plant should be equipped with instruments for the purpose of piling up records for historic use some centuries in the future? Apparently such engineers use instruments principally as ornaments to impress the operating force or the casual visitor with the thoroughness of operating methods employed in the plant.

Perhaps we could get more value out of instruments if we would occasionally consider that they were devised for the sole purpose of imparting information on the changing conditions about the plant. If the operating force and the management cannot make use of information imparted by an instrument, it has no practical value.

Machinery and instruments cannot do everything in a power plant. Back of the equipment must be human brains directing and controlling operation.

◆ A POUND of pure carbon requires 11.5 lb. of air for complete combustion. As coal is not all carbon, but contains a variety of ingredients, all of which vary in different coals, from 20 to 40 lb. of air per pound of coal is required. The difference between the theoretical quantity and the quantity practically needed is the "excess quantity," or "excess air," as it is called. "Too much excess air," then, means more than the quantity practically needed.

◆ Carbon Monoxide in Boiler Uptake

The presence of carbon monoxide gas in the uptake of a boiler indicates one or more of the following conditions: Poor design of furnace, improper methods of firing, poor fuel and equipment for burning it, improper mixing of the combustible gases with the air, low furnace temperature so that the gases are cooled below the ignition point, deficient air supply, molten fuel bed, fusion of the ash on the grates, dirty fuel bed or dirty fuel oil burners. Tests have shown that for every 0.1 per cent of CO in the uptake gases, a drop of 2 per cent in boiler efficiency results. This is not a straight line curve, but runs as follows:

Per Cent CO.....	0.1	0.2	0.3	0.4	0.5	0.6
Per Cent Efficiency	72	63	60	57	56	54

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TECHNICAL DEVELOPMENTS

The following abstracts are of the latest developments found in the foreign press.

IN THE PAPER INDUSTRY

◆ Aerator Save-All

Although a short abstract of the operation of Adolf Karlstrom's save-all (the so-called Adka) has been given previously in these pages, the operating principles will be repeated briefly, and the interested reader may visualize them by reference to the illustration in THE PAPER INDUSTRY, Nov. 1933, p. 470. In Figure 1 of the present abstract, which shows diagrammatically the lay-out of the backwater system) tank (A) is sealed at the top and bottom by convex domed plates. Through the upper dome passes a pipe (3) that serves as the rotating vertical shaft of a double worm gear drive. At its lower end (3) is connected with a horizontal suction pipe, ending in a suction nozzle (details of which are shown in Figure 2). This

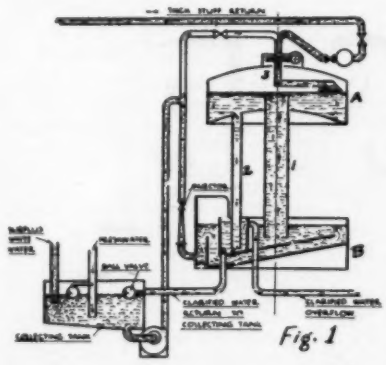


Fig. 1

nozzle is moved around the surface of the suspension in (A) at the periphery of the tank. At its upper end (3) is connected with a stationary suction pipe leading to a pump that maintains the necessary vacuum in (A) and serves to remove the pulp collecting at the surface (through the agency of the nozzle in Figure 2) and to return the stuff to the paper machine system. This top gear above the tank is shown in the halftone in Figure 3. The pipe which ends in the suction nozzle also carries a surface scraper, and on the wall of the tank, below the water surface, is a rake so placed that it is in the path of the nozzle. Through the bottom of the tank runs a pipe (1) of large diameter, the lower end of which dips into the open tank or box (B) as shown in Figure 1. B has an aerating compartment, a deaerating compartment, and finally a compartment for discharging clarified water and which also serves as a water seal for the vertical discharge pipe (2) in Figure 1. This same figure shows an injector, served by the backwater pump at the paper machine, which delivers the backwater to the aerating compartment of (B). De-aeration takes place largely in the inclined duct of (B). As the water rises in the direction indicated by the arrows in Figure 1 through (1), free air bubbles are removed and only dissolved air and air adhering to the

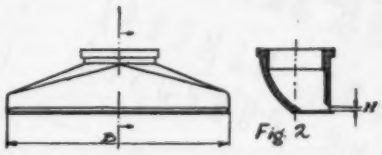


Fig. 2

fibers remain. These fibers rise to the surface in (A) where they are carried to the periphery and sucked up by the suction nozzle. The fibre-free water drops to the bottom of (A), and passes through an annular canal at the lower periphery of (A), and thence through suitable discharge pipes into (2) through which it flows into (B).

The author shows how the save-all design permits the change of paper stock and color. When the latter is changed, the Adka is automatically washed clean by means of arrangements indicated by Figure 1. While the wet end of the paper machine is being washed down, clear water from the save-all together with fresh water enters the collecting tank (at the extreme left). Since these save-alls are supplied with injectors of various sizes, the amount of water handled per hour may be varied at will. Save-alls of this type, erected in connection with a large board mill in the West of England (some of them handling 50,000 gallons per hour), yield water which seldom contains more than 30

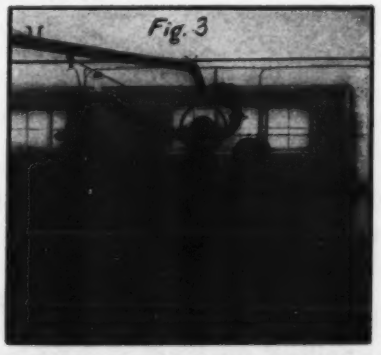
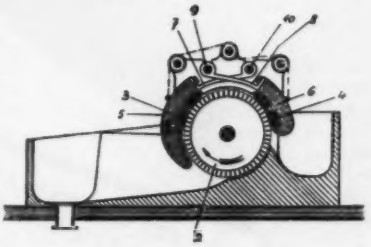


Fig. 3

parts of solids per million. Advantages claimed for the Adka are: (1) 95-100 per cent fiber recovery; (2) relatively small height and bulk of the equipment; (3) small water and pulp storage requirements; (4) ability to change color and quality of stock rapidly without pulp loss; (5) rapid automatic cleaning; (6) low upkeep and operating costs; (7) ability to handle wash water from knot screens and from all waters containing fibers. S. Anspach. Paper-Maker and Brit. Paper Trade J. 90, No. 4 (T.S.) 149-54 (1935).

◆ Beater

The figure shows two bedplates (or bedplate groups) (3) and (4) above the horizontal plane of the beater roll (2). These bedplates are fixed into bedplate carriers (5) and (6) respectively, and in turn these are connected with the scissors-shaped, easily removable levers (7) and (8), swinging about the fixed journals (9) and (10). The raising and lowering of (3) and (4), which drag over the upper half of the beater roll circumference, is effected regularly and simultaneously by cables or chains (indicated but not numbered in the figure)



operating over pulleys on suitable shafts, controlled by the (uppermost) central shaft. A hood (also not numbered in the cut) lies several centimeters above (2), and covers the space left open by (3) and (4). The lower end of the bedplate carrier (6) in conjunction with the back wall of the trough saddle, forms a sort of funnel for trapping the stock as it is ejected by (2). The pulp passes between about half the entire surface of the beater roll and the bedplates. This means that the space occupied by the stock during the beating is about twice that furnished in other types of beater construction. P. J. Wolff & Söhne, G.m.b.H. and Hermann Malickh. Düren. German Patent No. 612,-884. Kl 55c.

◆ Stock for Board Containing Synthetic Resins

In the production of electrical insulating boards, formed by impregnation with synthetic resins, the most satisfactory paper usually contains strong, clean, well-washed soda pulp. As a typical example the author cites the following properties (of which those given in parentheses were determined in the cross direction of the paper, while the

• Almost instantly soluble in water, making hard water soft, Tri-Sodium Phosphate is of interest to the paper maker.

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other figures were those obtained in the machine direction):—double folds, 3,000 (2,500); breaking lengths 9,600 meters (6,500 meters); stretch 3 per cent (6 per cent). The pop test showed 3 kg/cm². In insulating board manufacture, Manila paper may also be employed, although it is generally less satisfactory. The figures obtained by the author on a suitable paper of this type were:—thickness, 0.06 mm.; folding endurance, 3,000 double folds; bursting strength, 2.8 kg/cm²; breaking length, 6,300 meters; stretch, 3 per cent; weight, 50 g. per sq. meter. In the formation of plates, both sides of the sheet are impregnated with the resin. The sheets are then stacked and laminated under pressure and heat. Paper to be impregnated with synthetic resins must be free from latex size. Rosin size, however, does not interfere with subsequent treatments. Paper used for board manufacture should, in general, be dense, have a high absorptivity, and be smooth on only one side. For use in the manufacture of molded products, the paper should have a lower absorptive capacity than that used in board manufacture. Its weight per meter should also be lower, and only one side of the sheet should be treated with resin. Fritz Ohl. Wochbl. Papierfabr. 66 (Tech. Teil) 696-8 (1935).

◆ Slice for Paper Machines

The stuff reaches the wire in such a way that the fibers are suitably distributed and that felting takes place practically at the actual zone of contact. Thus it is claimed there is no necessity for a shake on the machine. This means a careful synchronizing of the rate with which the wire travels and of the velocity of flow of the stock to the wire. It also means that the stock must be suitably whirled. If working conditions change, the rate of flow changes automatically, depending on the variation in the speed of the main drive. The stuff flow is regulated by conveyor screws driven by the main drive. These serve also to impart to the fibers the necessary whirling motion. The device includes a series of plates located directly behind the conveyor worms, and oscillating across the machine direction. These serve to prevent the fibers from becoming orientated largely in the machine direction. Sheet formation, it is claimed, thus takes place at the very outset of the operation. Werner Reisten. German Patent No. 613380, Kl. 55d. (Cf also THE PAPER INDUSTRY, August, 1935, p. 351.)

◆ Fluted Rubber Rolls

The wide application of rolls, surfaced as shown diagrammatically in Figure 1, is discussed in this article. For example, the usual units in the wet end of the paper machine are the couch (or suction couch) rolls, and the various press rolls. A fluted rubber-covered roll (the so-called Imperial roll) has now been introduced in place of the upper couch roll. This eliminates the jacketing felt. Such a roll is shown in the halftone, in Figure 2. The claim is made that this permits the application of higher pressures without the danger of crushing, the sheet being guided by the flutes. Couch rolls of this type are now in successful operation, where webs weighing 1200 grams per sq. meter are involved. After leaving this couch roll, the texture of the web is so compact that the first press may be run without a felt, especially if the lower press roll is covered with fluted rubber. Water pressed out evidently does not dam up in front of the presses before draining. Figure 3 shows diagrammatically, a machine equipped completely with Imperial rolls. (Here the circumference is heavier, and the section of roll is shaded). Since wet felts may be dispensed with, the possibility of bringing the presses closer to each other in the paper machine is valuable when additional drying cylinders are to be installed. When the rubber fluting is worn down, the flutes may normally be reground in the machine shop of the paper mill. Application of fluted rubber rolls in filters and save-alls also is suggested. The roll design must be modified depending upon the type of stuff, the moisture content, the thickness of the web, and the pressure used. The type of rubber in the roll, its hardness, and the size of the section to be fluted are of importance in designing an Imperial roll. These depend on requirements of the stuff side, and may vary from press to press even in the same paper machine. Prof. Dr. von Lassberg. Zellstoff u Papier, October (1935); through Paper-Maker and Brit. Paper Trade J. 90, No. 6 (T.S.) 178-9 (1935).

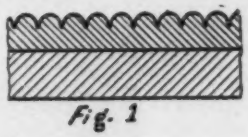

Fig. 1

Fig. 2

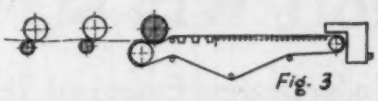

Fig. 3

◆ Is Lignin Actually Present in Wood?

Earlier investigations showed that sugars were converted into insoluble, lignin-like substances by 72 per cent sulphuric acid. This is especially true of xylose and fructose, whereas glucose, mannose and glucose—yielding polysaccharides give very slight precipitates. However, the conversion into lignin-like bodies disappears at low temperatures. Thus a means should be furnished for carrying out the lignin determination, without danger of precipitating conversion products of the carbohydrates. Soda pulp dissolves almost completely in 72 per cent sulphuric acid at 6 deg. C. without appreciable residue. Rye straw yields about 17 per cent of the so-called lignin at this same temperature, but at minus 12 to minus 15 deg., the straw dissolves completely with the exception of 2-3 per cent inorganic matter normally found in the ash.

When these sulphuric acid solutions are diluted, varying amounts of flocculent substances are precipitated, and these correspond in composition to $2(C_6H_{10}O_5)$ minus 1 H_2O, showing their generic relationship to the carbohydrates and indicating the presence of an anhydrocellulose. The mother liquor from these precipitates are water-white, and when cautiously neutralized and evaporated, yield a pale yellow substance, which reduces Fehling solution. Lignin seems to be completely absent, and this appears as evidence that at least one raw material that has hitherto been considered lignified (by chemists) actually contains no lignin in the classical sense of the term. When common beechwood is treated with fuming HCl at minus 10 deg. C., 12 per cent of a residue (A) remains. This residue has the following composition: 56.15 per cent C; 6.0 per cent H, and 12.8 per cent methoxyl. This lies between the composition of the original wood (49.3 per cent C; 6.0 per cent H and 6.2 per cent methoxyl) and that of the so-called lignin as isolated by other investigators (i.e., 60.0 per cent C; 6.2 per cent H; and 16.7 per cent methoxyl). If wood is treated at minus 10 deg. C with HCl (density 1.19) until 30-40 per cent has entered solution, the residue still has an elementary composition practically identical with that of the original wood. Hence (A) is not preformed in the wood, but is a reaction product. When (A) is heated with 43 per cent HCl under the usual conditions, it is converted into a body having 16.7 per cent methoxyl (i.e., into what is usually termed lignin). When the acid mother liquors from (A) are diluted with water a precipitate (B) is formed amounting to approximately 50 per cent of the weight of the original wood. This appears to be as lightly methylated cellulose anhydride with one methoxyl group for every 2 $[2(C_6H_{10}O_5)—H_2O]$. This substance, which is very closely related to the carbohydrates, is converted into a typical so-called lignin with a methoxyl content of 21 per cent, when treated with concentrated HCl at 15-20 deg. C. The mother liquor from (B) is water-white, and contains only carbyhydrates and water solubie matter, but here again, when the above acid treatment is repeated, the substances in this mother liquor are converted into lignin-like substances.

A sample of white beechwood, when treated with HCl, (d.1.19) at low temperatures, dissolved to the extent of 62 per cent. The residue then had the same

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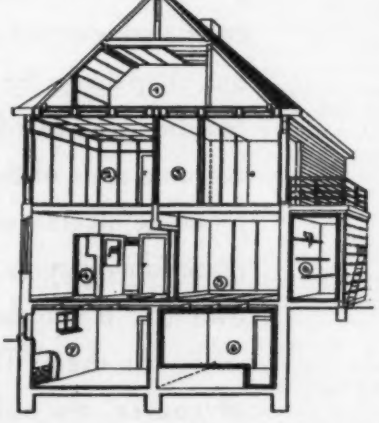
elementary composition as had the original wood. The percentage of methoxyl had increased slightly, but not appreciably, and the most surprising finding of all was that while the lignin (as determined by the usual procedure) of the original wood was 25.2 per cent, the apparent lignin content of the 37 per cent residue was only 33.6 per cent. Very evidently then this residue was certainly not lignin in the usual sense of the term. These are further pieces of evidence that lignin as isolated from beechwood is not preformed as such in the wood. It is impossible to calculate the lignin content from the methoxyl content in the original wood. The significance of these researches lies in the fact that they throw serious doubt on the existence of lignin as a non-carbohydrate component of woody tissues. (That this important and very suggestive new hypothesis is not entirely convincing has recently been claimed by Earl Kürschner) Cf. Zellstoff Faser, 32,132-4 (1935), R. S. Hilpert. Cellulosechemie, 16, No. 10, 92-6 (1935); Hilpert and H. Hellwage. Ber. 68, 380-3 (1935); Hilpert and E. Littmann. Ber. 68, 16-8 (1935); the 2 latter through Papierfabr. 33 No. 46 (Abstracts), 188-9 (1935).

◆ Cellulose Determinations by Means of Chlorine Dioxide

Using in principle the method of Erich Schmidt and his coworkers, the present investigators modified the one-stage treatment of fibrous materials with chlorine dioxide and pyridine (Cf. Schmidt, Tang, and Jandebeur; Cellulosechemie, 12, 206, 1931, and Chemical Abstracts 26, 1772). By increasing the ClO_2 concentration from 0.25 per cent to 1.5 per cent and the pyridine concentration from 0.55 per cent to 1.5 per cent, it was found possible to cut the period for the removal of encrusting matters from 29-30 days down to 8-9 days. (With 3 per cent ClO_2 and 5 per cent pyridine, this time period could be further shortened). However, with this change in method there was always a sharp decrease in the total percentage of the so-called skeletal substances. (These correspond rather closely to the holocellulose isolated by the U. S. Forest Products Laboratory method). While the new technique cannot be applied to the determination of these substances, into toto, it evidently does not affect the total cellulose, which may be isolated by its use, when 1.5 per cent ClO_2 and 1.5 per cent pyridine are employed. Five grams of Ginko wood (80-100 mesh) or wheat straw (40-60 mesh) were introduced into a brown calibrated flask and treated with 500-750 cc. of ice cold chlorine dioxide solution. The flask was sealed with a ground-in glass stopper, covered with a black cloth, and mechanically shaken for an hour. Subsequently the cloth is removed, the flask placed in ice-water, and a collodian-covered, two-hole cork stopper substituted for the carefully rinsed glass stopper. Through one of the stopper holes runs the tip of a 25 cc. burette, while the other is sealed with a glass tube. From the burette a suitable amount (usually 25 cc.) of 30 per cent pyridine is added to the mixture in the flask, which is shaken cautiously during the addition. The glass stopper is then reinserted, and the flask again shaken until free from lignin, by the phloroglucinol test. The residue is then filtered on a fritted glass crucible, thoroughly washed with water and then digested with cold 7 per cent NaOH solution containing 3 per cent NaCl. This yields a pentosan-free cellulose which gives no furfural (barbituric acid method) on distillation with 12 per cent HCl. In determining cellulose quantitatively by the above method, the initial sample was cut to 1.5 grams (and although the authors do not state what quantities of reagents are used, these are presumably decreased proportionately). The final removal of non-cellulosic material then involves thorough stirring with 15 parts by weight (based on the original sample) of the NaOH-NaCl mixture, after an initial washing with 30 cc. of this solution. The method when applied to cotton checked well with results by earlier procedures. Higher concentrations of chlorine-dioxide lead to slightly low figures. Wheat straw showed a cellulose-content of 42.3 per cent. Data are also given for the amount of skeletal substances in ginko wood. Yuan-Chi Tang and Hsioh-Li Wang. Cellulose-chemie 16, No. 7. 57-64 (1935).

◆ Building Board

Tabulated data are given, in which the thermal conductivity, the weight per unit volume, and the thermal resistances of about 30 important building materials are compared. These range from asbestos-cement and asphalt, down to linoleum, but the article emphasizes especially light building boards, which are



divided into 2 classes:—those made from wood wool and a binder, and (b) those which are actually fiber board. Class (b) has the greater practical significance. The thermal resistances referred to above are given in terms of the thickness in centimeters of brick masonry required to reach the resistance offered by 0.5 of any given building material. This figure is low (0.3) in the case of certain stones, and high (12.5 to 18.7) in the case of cork and fiberboard. The schematic sketch produced herewith, shows the so-called Kapag board used in the construction of houses:—(1) indicating the insulation of an attic, (2) ceiling and wallboard coverings, (3) the covering of either side of a thin partition, (4) insulation against sound of a telephone booth, (5) insulation of a floor under linoleum, (6) insulation of an adjoining chicken coop, (7) insulation of a cellar apartment, and (8) insulation of a refrigerating chamber. The author also tabulates all trade names, lists manufacturers, and gives the raw materials that are used in producing the most important boards sold on the German market. Brief descriptions of methods of manufacture used in various countries are given, and these are adequately illustrated. Edgar Mörath. Wochbl. Papierfabr. 66 (Tech. Teil) 624-5; 661-4 (1935).

◆ Surface Reactions in De-Inking

Empirical flotation experiments used in freeing printed papers from printers ink, and the detergent surface action of various substances are described. The flotation included foam formation, and the use of oil. The printed paper was disintegrated, and 20 and 40 gram samples were then subjected to flotation in a Ruth-apparatus of 4 liters capacity. This flotation was always continued until the froth appeared to be colorless. The fiber containing foam was skimmed off, and hand sheets were made from the residual purified stock and the relative whiteness determined by comparison. Whiteness of the colored stock was also determined. Numerous photometric tests gave rise to the following procedures. By using 5-10 per cent soaps of the fatty acids, very satisfactory purification was obtained. With fully saponified rosin soaps, extreme foaming occurred. The flotations were carried out in the presence of NaCl. The extreme foam (caused by resinates) trapped and caused the loss of a high percentage of fibers, and proved otherwise troublesome. The investigators then resorted to the addition of petroleum to the foaming mass, which cut down the foaming, and in general improved conditions of flotation. Using 3 per cent of rosin soap and a stock density of 4 per cent, the waste paper is disintegrated and the flotation carried out in the presence of 1.5 to 3.0 per cent petroleum. Usually this yields stock, the whiteness of which approaches that of the paper before printing. Printed papers made from bleached pulps are de-inked more readily than papers made from unbleached pulps. The process when applied to inferior grades of paper is not carried out as readily, but, in general, even under such conditions, the purification is reasonably satisfactory. Loading materials prove troublesome, since these are trapped in the foam. About 30 per cent of highly colored stock is usually skimmed off, and the yield of purified stock is generally 70 per cent. When the paper contains groundwood, this is preferentially trapped in the foam. In

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the case of pulps, it was found necessary to devise a special apparatus for the flotation. Kowalewskii. Bumashnaya Prom. (The Paper Ind. U.S.S.R.) 14, No. 3, 16 (1935); through Papierfabr. 33, No. 48 (Abstracts) 195 (1935).

◆ Radial Jet Compressor

The two illustrations show the compressor which is used in the steam circulation system devised by Holmes and Kingcome for obtaining high heat extraction and transmission in paper ma-

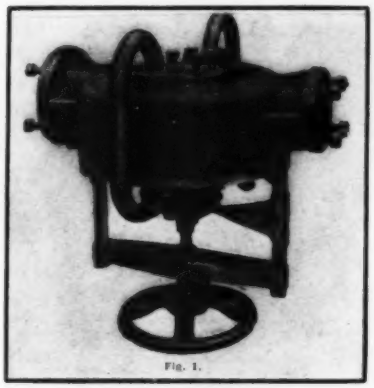

Fig. 1.

chines. The halftone (Figure 1) shows the apparatus. As shown in Figure 2, the jet arrangement is not fixed. A handwheel controls the nozzle part (A) and a flexible diaphragm (B), drawing them away from, or bringing them closer to

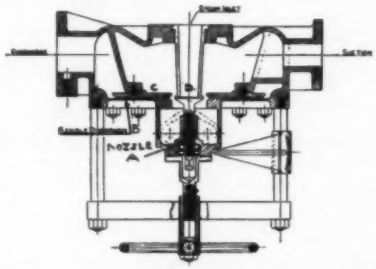

Fig. 2.

plate (C) and to the upper part of nozzle (D). The claim is made that this gives a much wider range of steam circulation than is possible when a fixed jet is used. Engineer. Paper-Maker and Brit. Paper Trade J. 90, No. 3 (T.S.) 132 (1935).

◆ Consensus of Opinion on Bleaching

As the result of a questionnaire sent out by the Austrian Section of the Verein der Zellstoff u. Papier-Chemiker u, -Ingenieure, it is generally agreed that aqueous chlorine and chlorine gas are more effective bleaching agents than are chloride of lime or hypochlorite. They possess the advantages of shortened bleach periods, and lessened consumption of power, steam and chemicals. However, chlorine bleach requires more wash water. The report also discusses the bleaching systems of Mason-Scott, Heiskanen, and Thorne. Anon. Papierfabr. 33 (Tech. Teil) 300-4 (1935).

◆ Strength of Jute Fiber

The strength of jute fibers subjected to tension, decreases with rising water content. Raw jute fiber, which is stored dry, retains its strength in this respect. Removal of lignin has little influence on the strength of the residual fibers, and this fact is used as an argument that cellulose and lignin are not combined chemically. Resistance to tension increases when the fiber is treated with formaldehyde which also augments its resistance towards bacterial action. P. B. Sarker. J. Indian Chem. Soc. 12, 23 (1935); through Papierfabr. 33, No. 48 (Abstracts) 198 (1935).

◆ Coatings for Concrete Surfaces

The author outlines very briefly the use of zinc sulphate, zinc fluorsilicate, and magnesium fluorsilicate in surfacing concrete. He then takes up the application of tetraethyl silicane (and its homologs) R_4Si in alcoholic solutions. These penetrate the surface and react with the lime to form calcium silicate. Freitag. Papierfabr. 66 (Tech. Teil) 476-7 (1935).

◆ ◆

◆ Cincinnati Rubber Expands Paper Mill Business

In order to take care of expanding business, the Cincinnati Rubber Mfg. Co., Cincinnati, Ohio is constructing an addition to its building which is used for the rubber covering for paper-mill rolls.

The new extension is to be 80 feet long and 50 feet wide, complete with the craneway. The Austin Company, of Cleveland, has the contract.

◆ New Expansion Planned in Finnish Pulp and Paper Industry

The pulp and paper industry is well represented among the new expansions planned by the Finnish manufacturing industry over the past year, according to *Side Runs of the Paper Trade*. A new paper mill is under construction at Johannes, near Viborg. The installation of machinery, ordered from Germany, is under way, and the mill is expected to be in a position to begin operation by April, 1936. The annual output will be about 5,000 metric tons (metric ton equals 2,205 pounds).

An order was recently placed by the Kymmene Company for another newsprint machine to be installed at their mill at Woikka. The new machine is of the three-reel-type with a 210-inch net width and a maximum speed of 450 meters per minute. It is similar to the one installed at the same mill in July. It is expected to be in running order not later than November 15, 1936.

New plants already in operation are the new sulphite mill belonging to the Pietarsaaren Selulosa at Pietarsaari, which started operation last summer with an annual output of 35,000 tons, and new installations in the plant of the United Paper Mills, Ltd. (Errki I. Kapy, American Consulate General, Helsingfors.)

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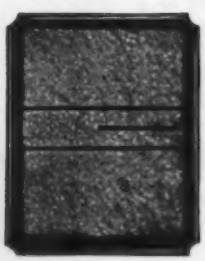

Hamilton Felts are marked by two blue lines full width of felt and by one blue line midway between them.

Hamilton Felts

PAPERMAKING PATENTS

Inquiries with reference to any of these patents should be addressed to James Atkins, Munsey Building, Washington, D. C.

IN THE UNITED STATES

Compiled by James Atkins, Registered Patent Attorney

19,821—Multiple-Ply Paper. Ezra B. Fish, Kansas City, Mo., assignor, by mesne assignments, to The Interstate Folding Box Company, Middletown, Ohio, a corporation of Ohio. Original application November 1, 1921. Serial No. 512,148. Divided and application May 2, 1923. Serial No. 636,198. Patent No. 1,552,286, dated September 1, 1925. This application for reissue September 12, 1935. Serial No. 40,349. 4 Claims. (Cl. 92—40). A paper sheet comprising a photographically opaque ply and a facing ply united permanently therewith by interlocking of the fibres of the plies.

2,021,612 — Pulp Treating Process. James S. Sconce, Niagara Falls, N. Y., assignor to Hooker Electrochemical Company, New York, N. Y., a corporation of New York. Application February 19, 1934. Serial No. 711,923. 10 Claims. (Cl. 8—2.) The process of treating a water suspension of cellulosic material which comprises reacting thereon with elemental halogen in the presence of calcium carbonate and lime, said lime proportioned to said halogen to maintain a non-alkaline condition in the suspension.

2,021,938 — Card or Paper Stock for Use in Duplicating Processes. Raymond S. Jones, Wynnewood, Pa. Application September 16, 1933. Serial No. 689,791. 1 Claim. (Cl. 41—31.6.) The process which consists in facially impregnating paper stock which is otherwise with a composition adapted to impart hygroscopicity to the faces only and transferring copy from a duplicating medium upon such paper.

2,021,947—Making Grease and Moistureproof Paper and Similar Material. John E. Schopp, Oak Park, Ill. Application September 12, 1933. Serial No. 689,161. 8 Claims. (Cl. 91—68.) A grease and water-proofing composition for paper and the like, comprising a water dispersion of approximately 23.7 per cent of rubber latex, casein, modified starch, a filler, a hygroscopic plasticizing material, and approximately 4.7 per cent shellac which, when dried, produces a flexible non-tacky coating.

2,022,004—Paper Sizing. Louis Leonard Larson, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware. No Drawing. Application July 1, 1933. Serial No. 678,727. 15 Claims. (Cl. 91—68.) A process of increasing the water repellency of absorbent material which comprises adding to said material an aqueous emulsion of polyhydric alcohol-polybasic acid resin, said resin having an acid number of 25 to 64 and containing in combined form from 65 per cent to about 90 per cent by weight of a polyhydric alcohol ester of an aliphatic monocarboxylic acid of the formula R—COOH in which R is an alkyl radical containing not less than 15 carbon atoms.

2,022,010—Paper Pulp Testing Device. Alfred Schopper, Leipzig, Germany. Application December 26, 1929. Serial No. 416,568. In Germany June 20, 1929. 9 Claims. (Cl. 73—51.) Paper pulp testing device comprising a strainer vessel having an opening in its bottom, a valve for closing said bottom opening, a sheave above said valve, flexible lifting means attached by one end to said valve and passing over said sheave, a drop weight attached to the other end of said flexible means, an additional weight associated with said drop weight and means for retaining said additional weight after said drop weight has traveled a predetermined distance.

2,022,298—Paper Making Machine. Maurice O. Neilson, Ottawa, Ontario, Canada. Application April 12, 1934. Serial No. 720,270. 17 Claims. (Cl. 92—44.) In a paper making machine, a slice, a housing across the front for the entire width thereof and a vertically adjustable lip therein.

2,022,311—Preparation of Pulps Containing Hard Binder Substances. Harry C. Fisher, Cincinnati, Ohio, assignor to The Richardson Company, Lockland, Ohio, a corporation of Ohio. Application June 27, 1932. Serial No. 619,520. 5 Claims. (Cl. 92—21.) A process of producing a pulp containing a binder substance which comprises mixing the said binder substance and fibrous material to the extent of forming a substantially homogeneous, plastic mass in which the fibres are included within the body of said binder, afterward mixing into said mass an additional quantity of fibrous material and water, whereby said mass is broken down in part at least, and finally beating off the combined mixture to form a pulp.

A pulp comprising uncoated feltable fibres in water suspension in combination with binder particles including coated fibres, said binder particles including coated fibres being in substantial part at least in intimate adhering contact with said uncoated fibres.

2,022,563—Process and Apparatus for the Formation of Channels in Sheets of Cardboard, Corrugated Cardboard, or the Like. Karl Hämmisch, Meissen, Germany, assignor to Aktiengesellschaft für Cartonnagen-Industrie, Dresden, Germany. Application February 17, 1934. Serial No. 711,718. In Germany February 18, 1933. 32 Claims. (Cl. 93—58.) A process for forming creases in sheets of cardboard and the like comprising first forming one side of the crease and thereafter forming the other side of said crease whereby the folding lines in the making of cartons and the like are produced.

2,022,654 — Treatment of Cellulosic Materials. Henry Dreyfus, London, England. Application February 28, 1934. Serial No. 713,309. In Great Britain March 7, 1933. 19 Claims. (Cl. 92—9.) Process for the production of cellulose from lignocellulosic materials, which comprises extracting lignin from the materials in solution in an organic solvent medium at an elevated temperature under a pressure in excess of that developed by the solvent medium at the temperature employed.

2,022,664—Manufacture of Cellulose from Lignocellulose Materials. Walter Henry Groombridge and Eric Vernon Mellers, Spondon, near Derby, England, assignors to Celanese Corporation of America, a corporation of Delaware. Application March 14, 1935. Serial No. 11,068. In Great Britain April 4, 1934. 12 Claims. (Cl. 92—9.) Process for the manufacture of cellulose from lignocellulosic materials, which comprises extracting lignin from the materials by solution in organic solvents or solvent mixtures which contain inorganic basic substances in amount between 0.5 and 8 per cent of the organic solvent or solvent mixture.

2,022,687 — Saturating Machine and Method of Using Same. Izador J. Novak, Bridgeport, Conn., assignor to Raybestos-Manhattan, Inc., Bridgeport, Conn., a corporation of New Jersey. Application October 30, 1933. Serial No. 695,756. Renewed February 16, 1935. 7 Claims. (Cl. 92—40.) A method of making a fibrous structure impregnated with a modifying material as a continuous operation, which comprises forming a fibrous web from pulp in aqueous suspension upon a continuously moving foraminated surface, and immersing said web while supported by said surface and prior to stripping therefrom by passing same through a permeating bath containing the selected modifying material in an aqueous vehicle to cause said web to distend and induce modifying material thereinto while maintaining the original formation.

2,022,799—Cutting Machinery. John Edward Blosser, Glens Falls, and Paul Burke, South Glens Falls, N. Y., assignors to Veldown Company, Inc., a corporation of New York. Application October 31, 1934. Serial No. 750,784. 7 Claims. (Cl. 164—60.) A machine for

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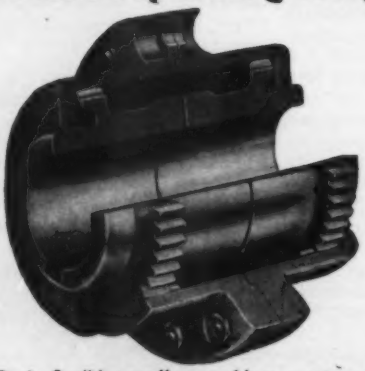

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cutting a log of paper into sections comprising a knife, a work table supporting the log, means to reciprocate said work table to bring said log into cutting position at intervals, an endless, constantly driven belt carried by said table and feeding the log of paper endwise, and means to eject the sections cut from said log comprising a series of paddles supported above said work table and means to move said paddles over the surface of said work table.

2,023,031—Boiler for Pulp Mills and the Like. Josiah H. Rohrer, Philadelphia, Pa., assignor to Badenhausen Corporation, Cornwells Heights, Pa., a corporation of Pennsylvania. Application June 22, 1931. Serial No. 546,020. 2 Claims. (Cl. 23—277.) Apparatus for treating waste wood-pulp liquor comprising in combination a vertical furnace having substantially vertical walls, means for introducing waste liquor into the upper part of said furnace for combustion of its organic constituents and recovery of its inorganic constituents, means for supplying air for combustion to said furnace, a tap hole at the bottom of said furnace for the removal of molten inorganic constituents of the waste liquor, a row of inclined cooling fluid tubes defining the roof of said furnace, a heating gas outlet from said furnace adjacent said roof, a steam roller arranged to receive heating gases from said furnace and comprising a bank of steam generating tubes extending across said heating gas outlet and arranged to absorb heat by radiation from said furnace, the front rows of tubes in said bank being more widely spaced apart than the rear tube rows of said bank to form a slag screen for said rear tube rows, a collecting hopper below said bank of tubes, means arranged to provide a flow of heating gases over the tubes of said bank, and conduit means connecting said roof tubes into the boiler circulating system.

2,023,163—Log Scrubbing Machine. Charles H. Burr, East Millinocket, Maine, assignor to Great Northern Paper Company, Millinocket, Maine, a corporation of Maine. Application June 3, 1933. Serial No. 674,202. 2 Claims. (Cl. 15—21.) Pulp log cleaning apparatus comprising a trough having a current of water that floats the logs crosswise down the trough, a rising and falling rotating brush disposed crosswise of the trough in position to ride upon and scrub the surfaces of and depress and rotate the advancing floating logs, and driving means for the brush.

2,023,200—Art of Molding Pulp Containers. Ernest Huff, Milwaukee, and Andrew Keiding, Whitefish Bay, Wis., assignors to American Lace Paper Company, Milwaukee, Wis. Application January 9, 1933. Serial No. 650,748. 10 Claims. (Cl. 92—54.) The process of manufacturing containers from fibrous pulp which includes the step of simultaneously drawing and rolling a hollow blank.

The process of manufacturing pulp articles which comprises the deposit-molding of a blank from size-containing pulp stock, the displacement of wet pulp from one portion of said blank to another portion thereof, the drying of the blank, and the application of pressure to the portion of the blank to which pulp was displaced, whereby to form the dry blank in a manner which, but for the excess of pulp deposited by such displacement, would destroy the set of the size and the rigidity of the blank.

2,023,357—Paper Toweling. Leo M. Harvey, Los Angeles, Calif. Application July 10, 1935. Serial No. 30,752. 9 Claims. (Cl. 281—5.) Toweling for use in a dispensing machine having a control member, said toweling comprising a continuous elongate sheet of fibrous material, said sheet having longitudinally spaced weakened zones penetrable by said member.

2,023,455—Pulp Shredder. John J. Warren, Brownville, N. Y. Application February 10, 1934. Serial No. 710,697. 9 Claims. (Cl. 92—20.) In a pulp shredder, the combination of a rotary shredder drum and a pair of rolls for feeding separate sections of pulp to the drum, one of the rolls being provided with sharp projections for impaling and gripping each section throughout its entire length and feeding it while so impaled to the drum.

2,023,681—Winding Reel. Henry L. Hall, Madison, Maine, assignor to Great Northern Paper Company, Millinocket, Maine, a corporation of Maine. Application September 25, 1934. Serial No. 745,412. 7 Claims. (Cl. 242—65.) In a winding reel for a paper web comprising a reel drum, a shaft parallel with the drum and disposed below the axis thereof, a pair of arms fixed to said shaft and extended upwardly in front of said drum, said arms having boxes at their upper ends adapted removably to support a winding roll against the periphery of said drum and to be moved away from said drum with the winding roll by the growth of the web on the roll, clutch mechanism for imposing a yielding restraint to the aforesaid movement of said arms, means including a hand wheel for operating said clutch, and means including a second hand wheel co-axial with said first wheel for swinging said arms manually in opposite directions.

2,023,711—Material Containing Parchmentized Fiber and Method of Producing the Same. Ervin E. Strawn, Passaic, N. J., assignor to Paterson Parchment Paper Company, Passaic, N. J., a corporation of New Jersey. Application July 27, 1932. Serial No. 625,219. 14 Claims. (Cl. 8—20.) The process which comprises applying to one surface of a porous cellulosic base an extremely thin coating composed of material that is not affected by the chemicals used in the parchmentization of fibrous matter and having sufficient fluidity to anchor itself thoroughly in the pores of said cellulosic base and then parchmentizing the base whereby that portion of the coating material which is contained in the pores of said base is caused to be tenaciously held therein by the parchmentized fibers of said base and the coating material which covers the surface of the parchmentized base is held thereto in inseparable relation.

A product comprising a layer of vegetable fibers parchmentized throughout its mass and a coating carried by said layer, a portion of the material constituting said coating penetrating the surface of said layer and extending into the body of said layer in the form of microscopic legs, said legs being tenaciously held in the body of said layer, in gripped relation, by the parchmentized fibers thereof so that that portion of the coating which covers the surface of said layer is held thereto in inseparable relation.

2,024,079—Apparatus for Drying Paper in a Continuous Web. William Whiting, Holyoke, Mass., assignor to Whiting Paper Company, Holyoke, Mass., a corporation of Massachusetts. Application May 11, 1934. Serial No. 725,218. 2 Claims. (Cl. 34—48.) In an apparatus for drying material in a continuous running web, in combination, a substantially straight line drying tunnel, a plurality of drying cylinders positioned at the inlet end of the tunnel between which the web passes and by which the moisture content of the web is reduced to a point short of where substantial shrinkage occurs, said cylinders advancing the web into the drying tunnel, a web conveyor in the drying tunnel which receives the web from said cylinders, said conveyor comprising a series of slatted open rolls of relatively large diameter, the rolls being spaced apart so that the traveling web sags between adjacent rolls and the shape of the portion of the web supported by each roll conforms to the curved surface of a section of a cylinder formed by passing a plane through each cylindrical roll parallel to its longitudinal axis, means extraneous of said web for driving the supporting rolls, other means for adjusting the speed of certain rolls with respect to other rolls so that all the rolls are driven at speed regulated to the shrinkage of the web and the initial speed imparted to the web by the drying cylinders whereby the web is advanced through the tunnel substantially without tension, means for causing currents of air to flow in said tunnel along both the upper and lower sides of the traveling web, and means to direct said air currents against the web, with a component of motion in the direction of web travel, throughout the length of the tunnel.

2,025,445—Wire Faced Roll for Paper Making Machines. Einar I. Flateboe, Everett, Wash. Application December 19, 1934. Serial No. 758,291. 6 Claims. (Cl. 92—48). In a wire faced roll comprising a skeleton drum consisting of a series of spaced spiders rigidly mounted on a shaft, and longitudinal rods carried by the peripheries of said spiders, the rims of said intermediate spiders having transverse grooves and said rods having cut-out portions interfitted with said grooves.

16 per cent Improvement

The one hundred and ten mills which competed in the Paper and Pulp Section Safety Contest for the year July 1, 1934 to June 30, 1935 showed a 16 per cent improvement over last year. These mills employed 42,378 men who worked 86,867,184 man-hours. The average frequency rate was 16.566, a marked decrease from the average frequency of 19.626 last year.

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Group A

Hollingsworth & Whitney Co., Algonquin & Taconnet Mill, Waterville, Maine, 2,449,530 hours, 11 injuries.
Bryant Paper Co., Kalamazoo, Mich., 1,491,538 hours, 9 injuries.
Canadian International Paper Co., Three Rivers, Quebec, 1,970,445 hours, 13 injuries.

Group B

St. Croix Paper Co., Woodland, Maine, 785,793 hours, no injuries.
Kimberly-Clark Corp., Niagara, Wis., 950,126 hours, 6 injuries.
Fraser Co., Ltd., Edmundston, N. B., Canada, 997,740 hours, 8 injuries.

Group C

International Paper Co., N. Tonawanda, N. Y., 548,504 hours, 1 injury.
The Crystal Tissue Co., Middletown, Ohio, 478,597 hours, 1 injury.
Escanaba Paper Co., Escanaba, Mich., 612,274 hours, 2 injuries.

Group D

Bird & Son, Inc., Phillipsdale, R. I., 216,581 hours, no injuries.
United States Envelope Co., Morgan Paper Co. Div., Lititz, Pa., 184,863 hours, no injuries.
International Paper Co., Livermore Mill, Chisholm, Maine, 158,610 hours, no injuries.
Spaulding Fibre Co., Inc., New Mill Plant, Milton, N. H., 125,879 hours, no injuries.
International Paper Co., Riley Mill, Riley, Maine, 116,298 hours, no injuries.

DIVISION II

Container Corporation of America, Natick, Mass., 166,846 hours, no injuries.
Texas Corrugated Box Co., Dallas, Texas, 141,340 hours, no injuries.
Southern Container Company, Houston, Texas, 129,016 hours, no injuries.
United States Gypsum Co., Genoa, Ohio, 82,084 hours, no injuries.

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An extensive line in standard and special types. Also bars to meet special requirements forged out of carbon alloy steels, stainless steel and bronze.

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The COMMERCIAL OUTLOOK

New York, February 1, 1936.

TO state that the paper industry is getting along in a satisfactory way might well be said to underestimate the actual situation. As a matter of fact, the industry is doing exceedingly well. From all corners of the trade come glowing reports of excellent orders for paper of various kinds, of demand gradually assuming broader volume, of the highly gratifying condition relating to consumption being reflected in larger operations of paper and board mills, of better-than-anticipated contract and other commitments for 1936, and of very pleasing prospects for a busy, favorable and profitable year for the paper and pulp industry.

The scope in which demand for some classes of paper has developed recently has really surprised paper manufacturers. It would seem as if consumers and converters in numerous cases have regained complete confidence in the stability and future of the paper market, and therefore have come in and covered their requirements freely and for a considerable time ahead. Orders have been received in a rush, in fact, and it can be said that paper mills—or at least a large majority of them—are today better fixed with business on their books than in a lengthy while. Moreover, demand is keeping up; whereas some buyers have let down after having filled their needs for a period, others are taking their places and are continuing the merry buying movement.

Two classes of the industry's products stand in bold relief as in an exceptionally active and strong market position. One is kraft paper, the other paperboard. Mills making these lines have been heavily occupied for some time past and are now well supplied with orders over the next few months. Nor is demand abating; instead, it is said that it is again on the increase after a seasonal quieting during the holiday period. Board mills are reported facing better prospects for 1936 than in many a year, following one of the liveliest periods in their history during the latter half of 1935. Kraft paper manufacturers apparently are cooperating in a manner leading to a happy marketing situation, and, supported by a broad demand from consuming quarters, are in a more favorable position than they perhaps have ever known.

Newsprint consumption is gradually mounting and mills in the United States and Canada, viewed as a group, are steadily increasing their output. Expressions of opinion are emanating from some parts of the industry to the effect that an actual shortage of print paper will be experienced within the next 12 to 18 months, provided the present rate of consumption increase is maintained. Writing paper mills are busier and have booked a good volume of business for the next few months. Tissue mills are in an improved position, and, all in all, the industry appears headed for one of the best years it has ever known.

"Industrial production for the full year 1935 probably was nearly 90 per cent of the 1923-1925 average, against 79 per cent for the full year of 1934, and 64 per cent for 1932," states Alexander M. Calder, president of the Union Bag & Paper Corporation, and a paper industry authority. "Department store and mail order house sales have, over the last two years, gone far toward reaching the record volumes attained in 1928 and 1929. The expansion in construction activities is one of the healthiest recovery indications; farm income for 1935 was about $400,000,000 more than in 1934; factory pay-rolls have expanded more than 50 per cent over the last 18 months. The immediate prospects, therefore, are bright. In 1929 the total production of paper in the United States amounted to about 11,000,000 tons, valued at slightly more than $1,000,000,000. In 1932, the worst year of the depression, the tonnage fell to a figure slightly above 8,000,000 tons, of the value of about $500,000,000. In 1935, it is estimated the tonnage was about 10,000,000 and the value about $750,000,000."

Predictions have been made in numerous parts of the trade that 1936 production will reach the previous record level of 11,000,000 tons, and may even surpass this total.

Mills in the United States and Canada produced 3,668,542 net tons of newsprint during the calendar year 1935, compared with 3,552,598 tons in 1934. This was an increase of 115,944 tons, or 3.2 per cent last year over the year before. Of this total in 1935, Canadian mills produced 2,752,735 tons and United States mills manufactured 915,807 tons. In 1934, Canadian mills produced 2,597,641 tons and United States mills 964,975 tons.

This was an all time high for Canadian mills, and compared with the previous top of 2,728,827 tons in 1929. For the United States, however, the downward trend has been in effect since 1926 when the high of the past decade was set at 1,684,218 tons. The last year to top the million-ton mark was in 1932 when 1,006,569 tons were turned out.

Newsprint production in December amounted to 244,732 tons in Canada and 75,869 tons in the United States, contrasted with 262,854 tons and 78,929 tons, respectively, in the preceding month, and 238,544 and 79,777 tons, respectively, in December, 1934. Shipments from mills in December last were 265,233 tons from Canadian mills, and 78,076 tons from United States mills.

Production of paperboard in the United States during November last totaled 294,290 net tons, according to Census Bureau figures, showing a seasonal decline from 345,596 tons produced in the preceding month but a big gain over the 227,733 tons produced in November, 1934. November output was at 73.6 per cent of mills' rated capacity, against 79.5 per cent in October last year and 57.8 per cent in November, 1934. The November production brought the aggregate for the first eleven months of 1935 up to 3,050,461 tons, representing a big gain over the 2,573,550 tons in the corresponding 1934 period, and also an increase over the 2,736,397 tons manufactured in the first eleven months of 1933.

New orders received by mills for board in November last called for 272,477 tons, compared with 351,887 tons in the month before, while unfilled orders on hand at the end of November were for a total of 88,971 tons of board, compared with 107,074 tons a month earlier.

◆ ◆

◆ New Board Mill for Cuba

According to *Side Runs of the Paper Trade*, two Havana firms which handle and use considerable quantities of chipboard or newsboard, are reported to have in mind the establishment of a mill in Havana for the manufacture of its product. At present their requirements are being filled by a local mill which is the sole Cuban producer of this product, since its competitor's plant was destroyed by fire in May, 1934.

A building located on the banks of the Almendares River in Havana is now being remodeled and prepared for the installation of machinery which will be bought in the near future. The plant will have a capacity of about 10 tons of chipboard or newsboard daily. The machinery will be operated by an electric plant installed in the building and it is hoped to have the plant in operation early in 1936. About 90 per cent of the raw material used will be waste paper and the rest pulp. Sponsors of this undertaking also are stated to be considering the manufacture of jute board and cardboard coated on one side. More than one-half of the daily production will be consumed by the two firms sponsoring the enterprise, and it is expected that a ready local market will be found for the remainder.

According to official statistics, Cuban imports of ordinary cardboard manufactured of waste paper, in natural color, rose from 331 metric tons in 1933 to 1,307 in 1934. More than 80 per cent of these imports was supplied by the United States.

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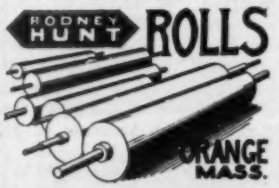

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Domestic RAW MATERIALS

◆ Papermaking Rags

Nearly all classes of papermaking raw materials are showing pronounced price firmness or else an advancing trend, and papermaking rags are no exception to this rule. As a matter of fact, it might be stated that rags, or some grades of them, have led the rise recorded during the past month. Some descriptions of new cotton cuttings have scored additional price rise; roofing rags have moved up again, and old white and blue cottons have strengthened quite perceptibly in market value.

It is becoming more and more apparent that the most salient factor in the firm rag market is the restricted amounts of suitable rags available. There is a decided scarcity of some grades, demand having developed a scope which has absorbed practically all the stocks that were held by packers and dealers, and fresh supplies being held up by lack of production in the case of new rags and curtailed collections in the case of old rags. Of course, this is the time of the year when collections are at the lowest, as unfavorable weather prevents gatherers from going out and getting rags, which situation will improve later on, but the fact remains incoming supplies at present are distinctly light and hardly fill the wants of buyers.

Dealers have marked up quotations on new cotton cuttings to where they are asking in most cases 7.50 to 7.75 cents a pound f.o.b. shipping points for No. 1 white shirt cuttings, 8 cents for soft unbleached muslins, 5.25 cents for light flannelettes, 5.25 cents for new light silesias, 6.50 cents for bleached canton flannels, 3 cents for fancy shirt cuttings, 2.50 cents for No. 1 washables, 5.75 cents for blue overall cuttings, and 8 cents for bleached hosiery cuttings. In some instances, above these figures are quoted, and it is nothing unusual for dealers to refuse to sell unless securing the full prices asked.

Roofing stock has risen a dollar or two per ton as regards domestic rags, while quotations on foreign roofing have advanced more than this. In the East, domestic No. 1 classification roofing is selling at 1.70 to 1.75 cents per pound f.o.b. shipping points, and No. 2 domestic at 1.40 cents. Importers ask 1.80 cents or higher for foreign dark cottons and up around 2 cents per pound for linsey garments ex dock New York, and assert it is difficult for them to get these rags abroad even to be sold at the prices mentioned. In fact, it is known that dark cottons have brought 1.80 cents in sales to dealers, which would infer dealers are paying as much as they are receiving for such rags in order to cover their commitments. Members of the trade are very bullish in their views regarding roofing rags. If residential building increases this spring and summer as anticipated, it is believed rag consumption for roofing felt will rise to a point where is will be extremely difficult to fill manufacturers' requirements, and that market prices consequently may move substantially higher.

Old whites and blues have firmed in price, dealers now asking 3.25 cents and in some cases higher for No. 1 repacked white rags at points of shipment, 2.15 to 2.25 cents for twos and blues and 1.90 to 2 cents for repacked thirds and blues.

◆ Old Paper

A steady movement of practically all grades into consuming mill channels, in conjunction with a lack of accumulation in packers' hands and a generally favorable supply condition from the standpoint of the seller, has made for firmness in waste paper prices and for slight advancement in some grades. There is a feeling within trade circles that market levels may go a bit higher before the winter ends, since incoming supplies at this time are at their lowest ebb. In the East, mills are paying 25 cents per hundred pounds f.o.b. shipping points for No. 1 mixed paper, and 37½ cents for folded news, while in the West, prices on these bulky stocks are 37½ cents on mixed and 42½ cents on folded news f.o.b. Chicago. White shavings have firmed up appreciably in price and are quoted around 2.25 cents a pound for No. 1 hard white and 2 cents for No. 1 soft white, with extra quality packing held for well above these prices. No. 1 hard white envelope cuttings have sold at 2.50 cents a pound f.o.b. dealers' points, No. 1 old kraft paper at 1.00 to 1.05 cents for the ordinary run of packing and 1.25 cents for extra quality, white ledgers at 1.30 cents per pound, and white blank news cuttings at 1.40 and 1.45 cents. Old books and magazines continue at the relatively low price level of 50 to 55 cents per hundred pounds for No. 1 heavy flat stock in the East.

◆ Rope and Bagging

Bagging prices remain firm although it would seem the sharp upward move of the market has been checked, at least temporarily. Values now are strongly established on comparatively high bases, with sellers exercising care in making commitments owing to difficulty experienced recently in locating available supplies. No. 1 domestic scrap bagging is about 2 cents a pound f.o.b. dealers' shipping points in the East, with sales in some cases recorded on a delivered western basis of 2.50 cents per pound. Foreign scrap is the same as domestic to perhaps a shade more in some instances. Roofing bagging has sold to mills at 1.50 cents f.o.b. shipping point or ex dock New York, and gunny bagging is firm at 2 to 2.10 cents for foreign ex dock Atlantic seaboard and 1.90 to 2 cents for domestic f.o.b. dealers' points. Old rope is tending to advance and favored with more demand. Paper mills are reported bidding 2.25 cents a pound for No. 1 domestic old manila at shipping points and to be paying above this price or up around 2.30 or 2.35 cents ex dock basis for foreign old rope.

◆ Pulpwood

Pulpwood prices are steady to firm, with a forward tendency observed. Contracts for this year have been, in practically all cases, on at least a slightly higher scale than last year. Demand currently is reported of fair compass.

◆ Mechanical Pulp

For the first time in a considerable period, mechanical pulp has staged a fairly sharp price rise. The advancement has not been broad but at any rate sufficient to carry the market higher than it has been in a lengthy while. Most groundwood is quoted at a minimum of $22.50 per short ton ex dock New York or other Atlantic ports, this being the minimum basis established for the first quarter of 1936. However, the market has moved beyond this level to where Scandinavian dry groundwood has been sold at $23 and $23.25 per short ton ex dock basis. Also, some Canadian pulp is now held for at least $23 a ton at American Atlantic seaboard. Domestic groundwood is nominally $23 or $24 or thereabouts f.o.b. pulp mills, depending on the freight haul to consuming points. Demand is reported fair, and severely cold weather in many grinding regions has so diminished production that the supply condition has become much firmer.

◆ Chemical Pulp

The market for chemical wood pulp exhibits a truly firm undertone. Aside from kraft pulp, which has registered a further strengthening in price during recent weeks, there has been no actual uptrend in market levels, but quotations are firmly adhered to and sellers are not hesitating to turn down orders at anything even so much as smacking of a price concession. Bleached sulphite is fully established on a 2.50 cents per pound basis ex dock American Atlantic seaboard, with higher grades ranging up to 2.65 and 2.75 cents. Prime unbleached sulphite is 1.90 to 2.05 cents ex dock basis, and bleached soda pulp is 2.50 cents delivered paper mills. Domestic or Canadian kraft pulp is about 2.10 to 2.25 cents a pound delivered consuming centers.

◆ Chemicals

Solid caustic soda is quoted at 2.55 to 2.60 cents per pound f.o. b. works, and displays quotable firmness. Soda ash is 1.20 cents a pound for bag shipments at works. Casein is firm at 15 to 15.50 cents for the domestic, and 14 to 14.50 cents for imported, according to the grind.

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Import and Export MARKETS

IMPORTS

◆ Wood Pulp

The market for imported wood pulp has continued to accumulate strength, and has registered advancement in some classes of pulp, with others displaying pronounced firmness. The situation has reached a point where sellers, without any question, hold the upper hand. Producing mills abroad are well sold ahead; not only have they contracted on a large scale for all of 1936, but in some instances purchases have extended well into 1937 and even as far ahead as 1938. In short, it would seem that paper and board manufacturers, having regained confidence in the pulp market, have proceeded to cover their requirements for a considerable time into the future, and appear prepared to buy farther ahead if enabled to secure the supplies wanted. However, so many producers have disposed of so much pulp in recent months that they no longer are eager to enter additional sales commitments and are refusing to book more orders. Moreover, the insistent demand coupled with the strengthening supply position has brought about a rise in prices of some kinds of pulps.

Sales of prime Scandinavian kraft pulp for spot or near delivery have been made at 2 cents per pound ex dock American Atlantic seaboard. Prime kraft for forward shipment from abroad has been sold at 1.90 cents, and probably up to 1.95 cents. It is said in the trade that it is doubted whether any prime kraft is longer to be had under a price level of 1.90 cents, although it is also stated that some supply perhaps is available at 1.85 cents. Kraft mills in Sweden and Finland are just about sold out for the current year, it is said, and in most cases seem little disposed to consider further sales, even at top market prices. When it is considered that only a comparatively short time ago, the kraft pulp basis was 1.70 cents ex dock American Atlantic seaboard, it can be seen that this division of the chemical pulp market has recorded a fairly sharp advance.

Sulphite quotations are firm of tone and fully maintained but have not moved from the levels established for some while. The feature in sulphite is that demand has assumed such dimensions that many producing mills have become sold up, particularly bleached sulphite plants, and as a result it is next to impossible for buyers to purchase a pound of either bleached or unbleached sulphite at below the prices which have ruled for a long time as minimum market levels. Prime bleached sulphite is 2.50 cents upwards per pound ex dock Atlantic seaboard, with higher grades 2.65 cents and more, while strong prime unbleached sulphite is 1.90 to 2.05 cents ex dock, depending on grade.

Groundwood has stiffened perceptibly in price. Sellers in Scandinavia are not pressing for orders as they were and have advanced quotations to where $23 to $23.50 per short ton for dry and $22 to $23 for moist pulp is demanded ex dock American Atlantic seaboard.

Imports of chemical pulp into the United States in November last amounted to 178,447 net tons of 2,000 pounds, air dry weight, valued at $6,676,218, according to official U. S. Department of Commerce figures, showing a decline compared with 204,154 short tons of a value of $7,733,386 in the preceding month, but a gain over the 130,411 long tons of a value of $5,484,323 imported in November, 1934.

Mechanical pulp imports in November last amounted to 21,090 short tons, valued at $387,928, making a total for the first eleven months of 1935 of 165,122 short tons, compared with 152,708 long tons in the similar time of 1934.

◆ Paper

Imports of paper and paper products into the United States in November were only slightly in excess of the perceding month, but were 20 per cent higher than in the corresponding month of 1934. Imports of newsprint paper, which accounted for $8,109,299 out of a total importation of $9,129,957, showed a rise of 5 per cent in volume and also value compared with the preceding month, and were 15 per cent higher than in November, 1934. Imports of the remaining paper and board and products, with a valuation of $1,020,658, were 16 per cent above the corresponding month in 1934 but showed a decline of 18 per cent compared with October last year.

Imports of paper and paper products in eleven months of 1935 were valued at $84,034,368, against $78,210,814 during the corresponding period in 1934. Imports of newsprint, which account for roughly 85 to 90 per cent of this trade, showed a more or less steady increase month by month last year, the total for eleven months amounting to 2,133,440 short tons.

◆ Paper Stock

Imports of papermaking rags into the United States in November last amounted to 15,758,644 pounds, valued at $159,677, bringing the total for the first eleven months of 1935 up to 175,141,150 pounds of a declared value of $2,068,792, contrasted with 96,843,126 pounds of a value of $1,243,512 in the similar eleven months of 1934. Imports of other paper stock, comprising old rope, bagging, waste paper, etc., during the first eleven months of 1935 were 68,706,318 pounds of a value of $975,097, against 49,153,552 pounds of a value of $716,091 in the corresponding 1934 period. Imports of all paper stock excepting wood pulp in eleven months last year recorded a 52 per cent increase in volume and 55 per cent in value over the same time during 1934.

EXPORTS

Exports of paper and paper products from the United States in November were approximately on a level with the preceding month. Some notable increases were registered in the volume of shipments of uncoated book papers, boxboards and other boards, overissue newspapers, and paper bags.

Compared with the corresponding month in 1934, the November shipments showed an increase in value of 7 per cent. This rise was more or less characteristic of the trend in paper exports throughout 1935. Subject to the usual seasonable fluctuations, exports of paper showed a substantial rise from the outset of last year; in only two months—August and September—was there a drop in the value of such exports compared with the corresponding months in 1934, and these declines were more than offset by the rise in the October, 1935, shipments to $1,912,715, an increase of 23 per cent over the October, 1934, exports. November shipments showed a further rise to $1,936,663, bringing the total for the eleven months of 1935 up to $18,856,565, compared with $17,357,479 during the same time of 1934.

Exports of newsprint paper in eleven months last year were valued at $813,057, compared with $877,596 in the similar period of 1934; of uncoated book paper, $950,767, against $822,410 in 1934; of wrapping paper, $1,693,944, against $1,813,774; of writing paper, $1,478,645, against $1,154,209; of tissue and crepe paper, $559,795, against $598,869; of toilet paper, $607,725, against $547,354; of fiber insulating board, $1,188,557, against $908,956; of boxboard, $1,049,033, against $880,249, and other paperboard, $964,901, against $717,114.

The increase in exports of paper base stocks from the United States was proportionately larger last year than of paper and board. Exports during eleven months of 1935 reached a total value of $8,581,183, against $7,242,699 during the corresponding period of 1934.

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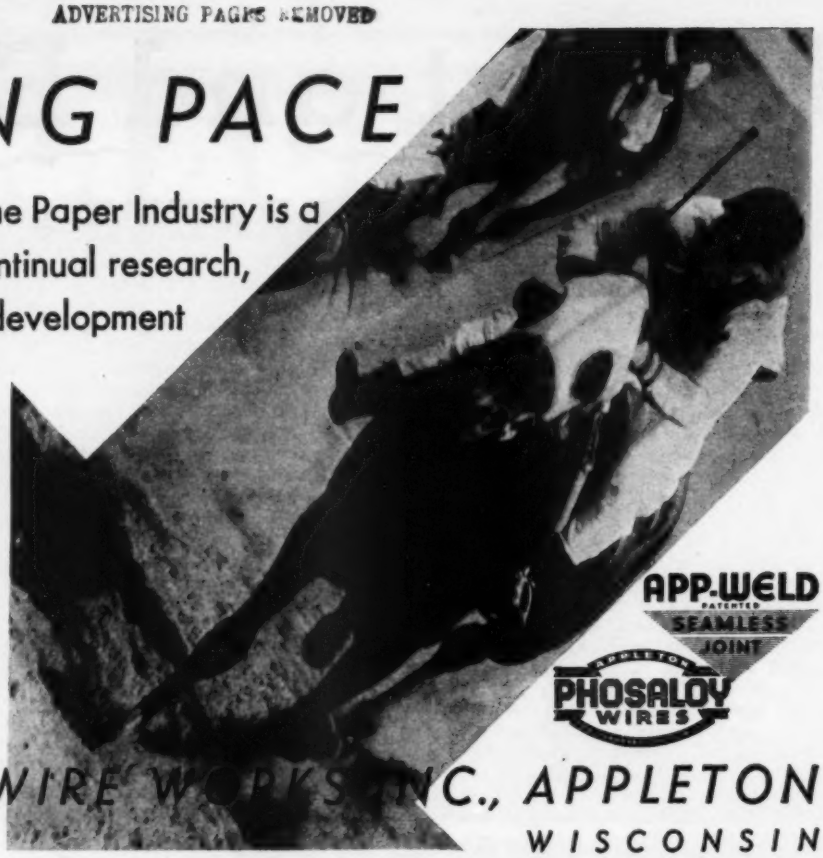

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